FLYING

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DETROIT

OUR PLAN FOR PRIVATE FLYING

by T. P. WRIGHT

Administrator, Civil Aeronautics Administration

SEE PAGE 24

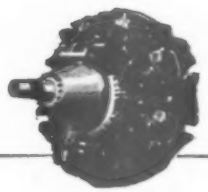
Warehouse on Wings

If all his sources of supply were just across the street, a retailer could cut inventories to the bone, yet never miss a sale. Now, by specifying delivery via air, a merchant can in effect move those warehouses next door. Ordering just ahead of the market, he can ride the peak of a season, or a style, or a rush for a new product. His capital turnover is rapid; he needs less credit. Overstocking of highly expensive or seasonal items is avoided.

But the list of items which can move economically in the warehouse on wings is not long enough at present. The job now is to explore all fields of merchandising, to find more goods which can travel via air with benefit both to merchant and to air carrier.

Still another job is to bring rates down so additional goods can move economically via air. Such rates evolve from maximum efficiency of operation and also from full payloads. Wright Cyclone engines, with a payload bonus due to their lower weight ratio, and with ease of maintenance and low fuel consumption to provide efficiency, are helping to make such rates a reality.

WRIGHT AERONAUTICAL CORPORATION
Paterson, New Jersey, U.S.A.



Cyclones Save 3 Ways

LESS WEIGHT—MORE PAYLOAD
LOWER FUEL CONSUMPTION
REDUCED MAINTENANCE

WRIGHT
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A Division of
CURTISS-WRIGHT CORPORATION

WRIGHT POWERS THE TONNAGE OF THE AIR

Northrop Black Widow—world's largest, most powerful pursuit plane

How fast can De-Icers fly?

We couldn't go fast enough to find out . . . even in one of our newest fighters

SOME PEOPLE will be surprised to see B. F. Goodrich De-Icers on the Northrop P-61 Black Widow. They'll be surprised because they never thought De-Icers could stand the terrific strain of this fighter plane's speed.

New Type Eleven B. F. Goodrich De-Icers stood it all right. The fact is, under test, these De-Icers took all the speed the Black Widow could turn up . . . and operated efficiently.

We can't give you this speed. We can say it was the fastest De-Icers have ever flown. And we still don't know how much *faster* they can go.

The important thing is that some of our new fighters are now going to have the "insurance" of De-Icer protection. For the Army has approved the use of Type 11 De-Icers for fighters, and they're already in production.

There are many reasons for the superior performance of these new De-Icers. Refinements in construction and design have resulted in a smoother cross-section, better tubes, greater tear-resistance. These De-Icers are lighter, last longer, remove ice better and cost less to maintain.

Perhaps you would like more complete data. If so, write to The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.

Skyway or Highway

B.F.Goodrich

FIRST IN RUBBER

APRIL, 1945

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A DISTINGUISHED NEW NAME FOR A DISTINGUISHED OLD SCHOOL

CAL-AERO TECHNICAL INSTITUTE

MAJOR C. C. MOSELEY — PRES. SINCE 1929

FORMERLY CURTISS-WRIGHT TECHNICAL INSTITUTE

FOR YOUR AVIATION CAREER

CAL-AERO TECHNICAL INSTITUTE (formerly Curtiss-Wright Technical Institute) established in 1929, is one of the oldest, largest and most successful Aeronautical Schools in the country, specializing in Aeronautical Engineering and Master Aviation Mechanics.

"Cal-Aero" and the schools under the personal supervision of Major C. C. Moseley, president since 1929, have an unmatched and unparalleled record of efficiency and safety in the training of military personnel. Highly honored by citations for distinguished service in training more than 20,000 pilots and 7,500 crew members, for the Army Air Forces, this school at the same time graduated thousands of civilians for the production front. Today as in the past Cal-Aero Technical Institute is training far-sighted, conscientious young men from many states and foreign countries, despite the difficulties of wartime travel. They are preparing now for a FUTURE CAREER in the expanding field of Aviation that is bound to come with the postwar activity in the air.

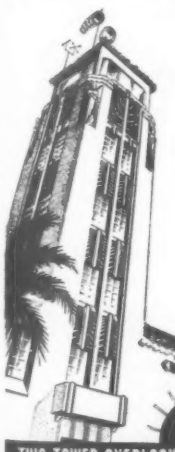
LOOK AHEAD—America is going to fly—for pleasure, for business and for commerce. The future of aviation is clear, definite, assured. The post-war era will establish the airplane as an instrument of peace. Military transport lines have shown the airplane to be an indispensable factor. Civil Aeronautics Administration estimates that there will be 500,000 civil aircraft in America alone by 1950. Bankers and conservative men are investing millions in post-war aircraft activities. These men do not gamble wildly with that much money; they invest carefully and conservatively. They know that aviation today is a 20 billion dollar a year business—five times the automobile peace-time peak. They also know that it can shrink 90% after Victory and still be "Big Business" (Air Market Report No. 2).

FEW MILITARY PLANES CAN BE CONVERTED TO CIVILIAN USE. People cannot afford to fly a fighter plane or bomber. New aircraft must be designed and engineering for each model must be thorough. Planes must be simplified, costs lowered and engineering development must precede production. Flight strips, airports, hangars, and maintenance units must be built by the many thousand cities and towns that will demand a place to "take off and land." A town without an airport will be like a town without a railroad station. All this, in addition to airline and post-war commercial expansion. In light of this school's assured confidence in the future of aviation, "Cal-Aero" has purchased outright the famous Grand Central Air Terminal* in Glendale, California, in order that Cal-Aero Technical Institute will enter the post-war aviation, larger, stronger, finer and more substantial than ever before. Same experienced management—same personnel—with the latest modern up-to-the-minute equipment and course of instruction.

PLAN NOW WITH CONFIDENCE FOR YOUR FUTURE CAREER IN AVIATION, and remember this: The highly trained man with a thorough foundation of technical training is always in demand, and will be in line to fill positions of trust and responsibility, thereby enhancing his earning capacity.

Flight training is restricted to Army Air Force cadets for the duration.

*Grand Central Airport (originally acquired by Curtiss-Wright Corporation in 1929 at a cost of almost $3,000,000), has been classified Class IV by C. A. A.—"Suitable for the largest aircraft in use or planned for the immediate future."



THIS TOWER OVERLOOKS AVIATION'S MOST DISTINGUISHED SCHOOL OF AERONAUTICS

TO DISCHARGED VETERANS

Cal-Aero Technical Institute is included in the list of approved schools on file with the Veterans' Administration, making discharged veterans, who attend, eligible for educational benefits as provided in the "G. I. Bill of Right."

If an Aviation Career is your choice, consider training for that career, at Cal-Aero Technical Institute, in Southern California, in the heart of the Aircraft Industry.

CAL-AERO TECHNICAL INSTITUTE

FORMERLY CURTISS-WRIGHT TECHNICAL INSTITUTE

GRAND CENTRAL AIR TERMINAL
1225 AIRWAY, GLENDALE 1, CALIFORNIA
(LOS ANGELES COUNTY)

UNDER PERSONAL SUPERVISION OF MAJOR C. C. MOSELEY, PRESIDENT AND FOUNDER, SINCE 1929

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MAIL TODAY • DON'T DELAY

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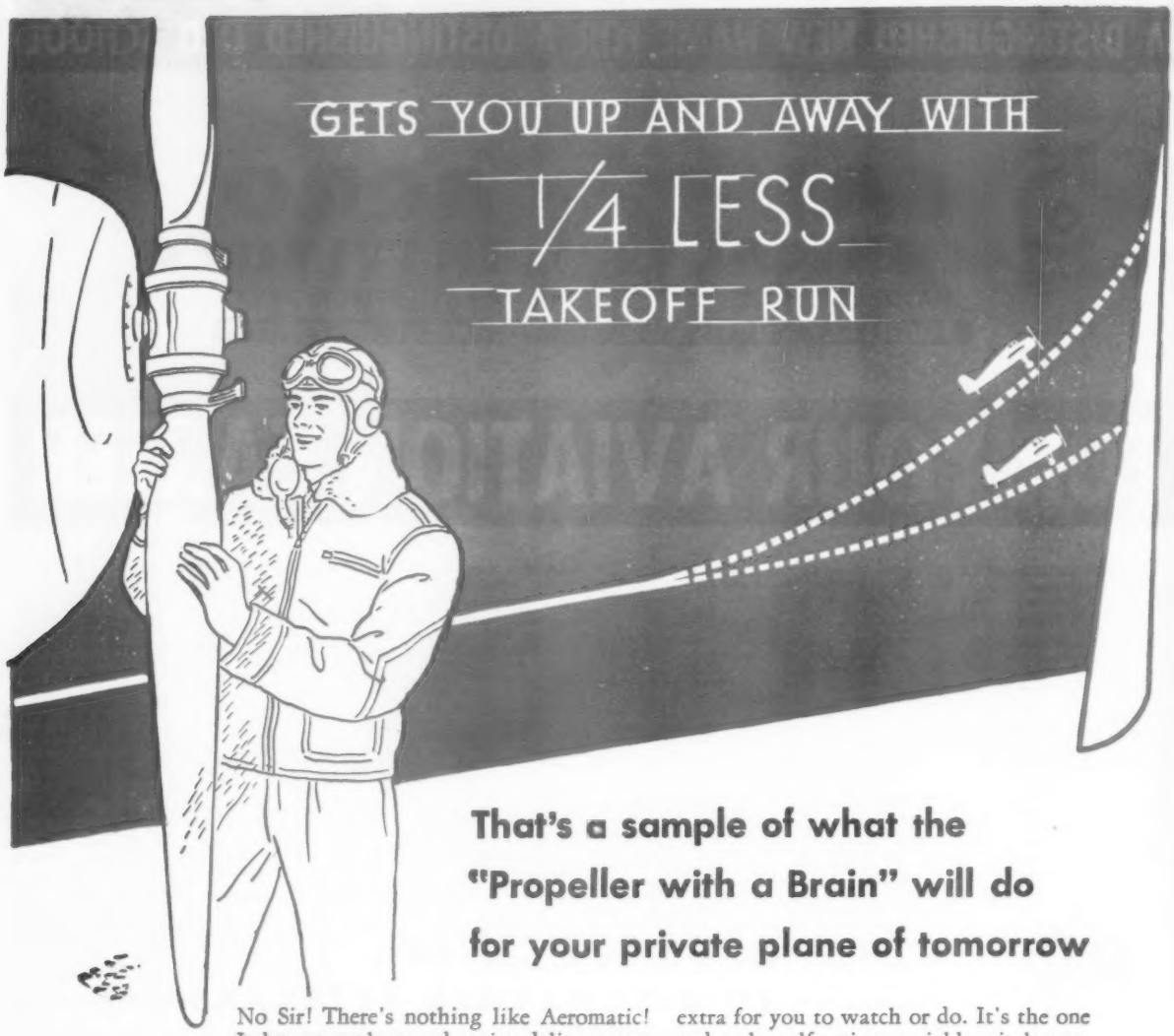


That's a sample of what the "Propeller with a Brain" will do for your private plane of tomorrow

No Sir! There's nothing like Aeromatic! It lets your plane and engine deliver automatically—*as no other propeller can*—ALL the performance that's built into them.

That's why an Aeromatic means one-fourth shorter takeoff runs. One-third higher rate of climb. Greater cruising range and speed. With minimum fuel consumption and engine wear. And Aeromatic means long glides for happy landings—with an instantaneous change of pitch for a quick pickup if you overshoot the field or landing strip.

More than that, the Aeromatic requires no instruments . . . no controls . . . nothing extra for you to watch or do. It's the one and only self-acting variable pitch propeller . . . the one and only propeller that automatically assumes the correct pitch for peak performance under any and all conditions of flight.

If you fly, or plan to fly, you'll want an Aeromatic Propeller on your plane. Write to your aircraft manufacturer about it today. And if you'd like our little get-acquainted folder, containing a diagram of the "brain" in an Aeromatic Propeller, don't hesitate to write to Aeromatic, 234 Scott St., Baltimore 3, Maryland. We'll be glad to hear from you.

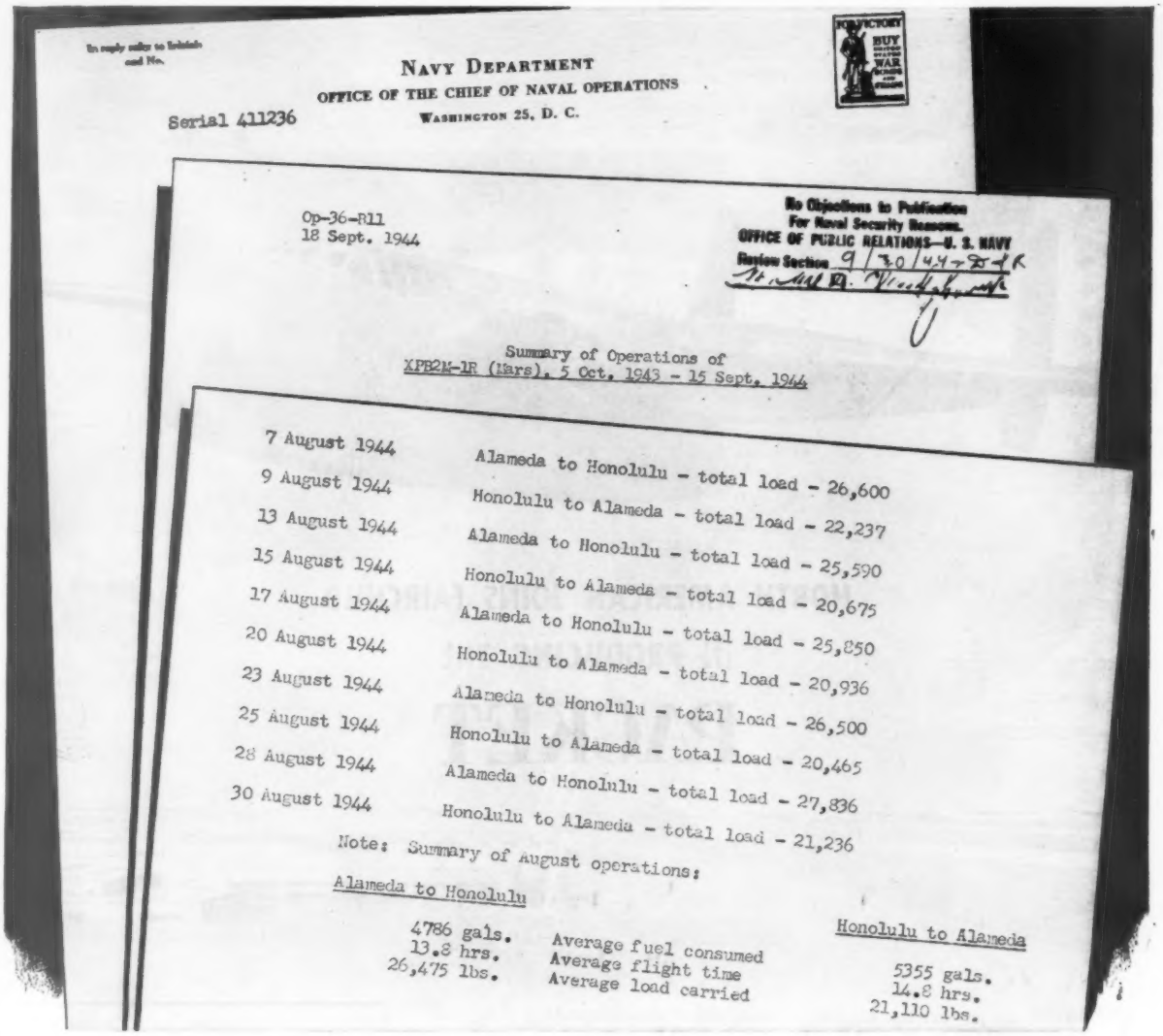
The Propeller with a Brain for Tomorrow's Plane

Aeromatic

Air Controlled *Automatic Propeller*

KOPPERS COMPANY, Inc., BARTLETT-HAYWARD DIVISION

Licensed under patents of EVEREL Propeller Corporation



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NAVY DEPARTMENT
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON 25, D. C.

Serial 411236

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

Op-36-R11
18 Sept. 1944

No Objections to Publication For Naval Security Reasons. OFFICE OF PUBLIC RELATIONS—U. S. NAVY Review Section 9/30/44-DK

Summary of Operations of
XPB2M-1R (Mars), 5 Oct. 1943 - 15 Sept. 1944

7 August 1944	Alameda to Honolulu - total load - 26,600
9 August 1944	Honolulu to Alameda - total load - 22,237
13 August 1944	Alameda to Honolulu - total load - 25,590
15 August 1944	Honolulu to Alameda - total load - 20,675
17 August 1944	Alameda to Honolulu - total load - 25,850
20 August 1944	Honolulu to Alameda - total load - 20,936
23 August 1944	Alameda to Honolulu - total load - 26,500
25 August 1944	Honolulu to Alameda - total load - 20,465
28 August 1944	Alameda to Honolulu - total load - 27,836
30 August 1944	Honolulu to Alameda - total load - 21,236

Note: Summary of August operations:

Alameda to Honolulu		Honolulu to Alameda
4786 gals.	Average fuel consumed	5355 gals.
13.8 hrs.	Average flight time	14.8 hrs.
26,475 lbs.	Average load carried	21,110 lbs.

Official Navy Records Show . . .

The Martin Mars Means Ease of Maintenance!

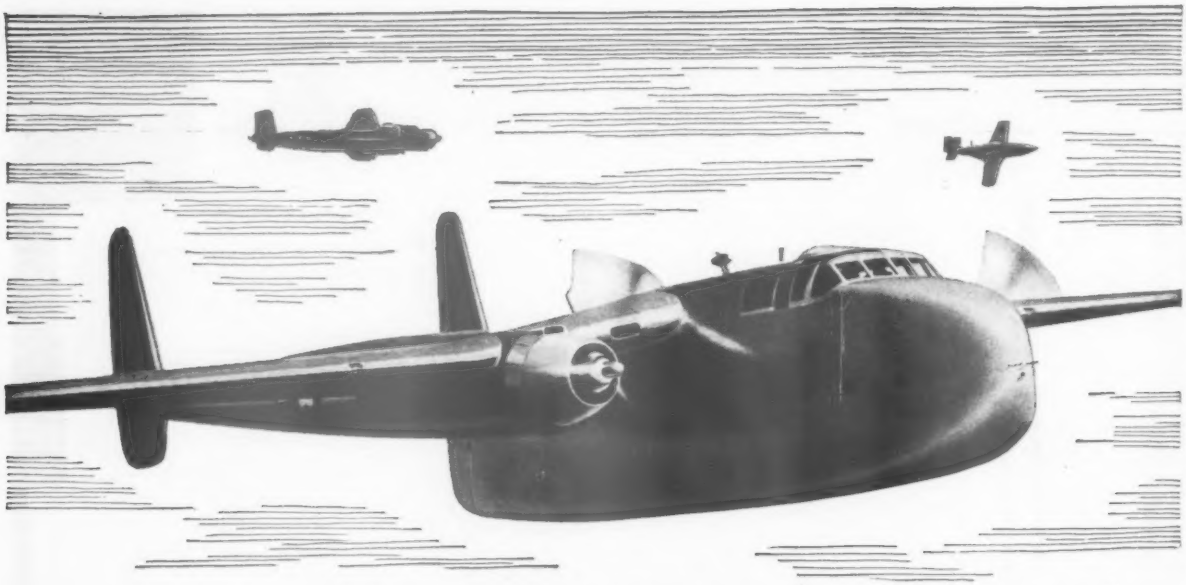
TAKE a look at the above Navy release and you'll see why we say the Martin Mars means ease of maintenance. Only one page of the release is shown, detailing operations for August 1944. Between the 7th and the 30th of that month the Mars made 10 trips between Hawaii and the Mainland. Since then she has steadily stepped up performance and in November completed 14 flights between Hawaii and California, flying a total of 33,600 miles and carrying more than 300,000 pounds of cargo. Her current utilization is 9.7 hours per day.

This high availability of Mars flying boats will pay substantial dividends to postwar airline operators. Less time for overhaul means more time in profitable operation. This savings, along with unusually low ton-mile costs and the fact that war's end will find Mars assembly lines tooled and manned for postwar delivery at a minimum purchase price, all combine to make the most economical overocean aircraft yet built. Companies interested in detailed performance data on the Mars, write

THE GLENN L. MARTIN COMPANY
BALTIMORE 3, MD.

Martin AIRCRAFT

Builders of Dependable Aircraft Since 1909



NORTH AMERICAN JOINS FAIRCHILD IN PRODUCING THE

PACKET

AMERICAN air power, the mightiest on earth, was built by teamwork with American industry. Into our ships of the air go the efforts of manufacturers and suppliers great and small.

The Fairchild "Packet," the Army's newest and most efficient carrier of air cargo, was built by this kind of teamwork: The teamwork of the Army with Fairchild designers and engineers, Fairchild sub-contractors, builders of engines, suppliers of metals, the sub-assemblers and fabricators of myriad parts and materials!

Now the Army Air Forces have designated North American Aviation, Inc., as another builder of "the flying boxcar." Fairchild welcomes this newest member of the "Packet"-building team, famed for the B-25 Mitchell Bomber; the superlative fighter, the P-51 Mustang; and the AT-6 Texan.

Soon the "Packet" will be coming down the runways from both Fairchild and North American.

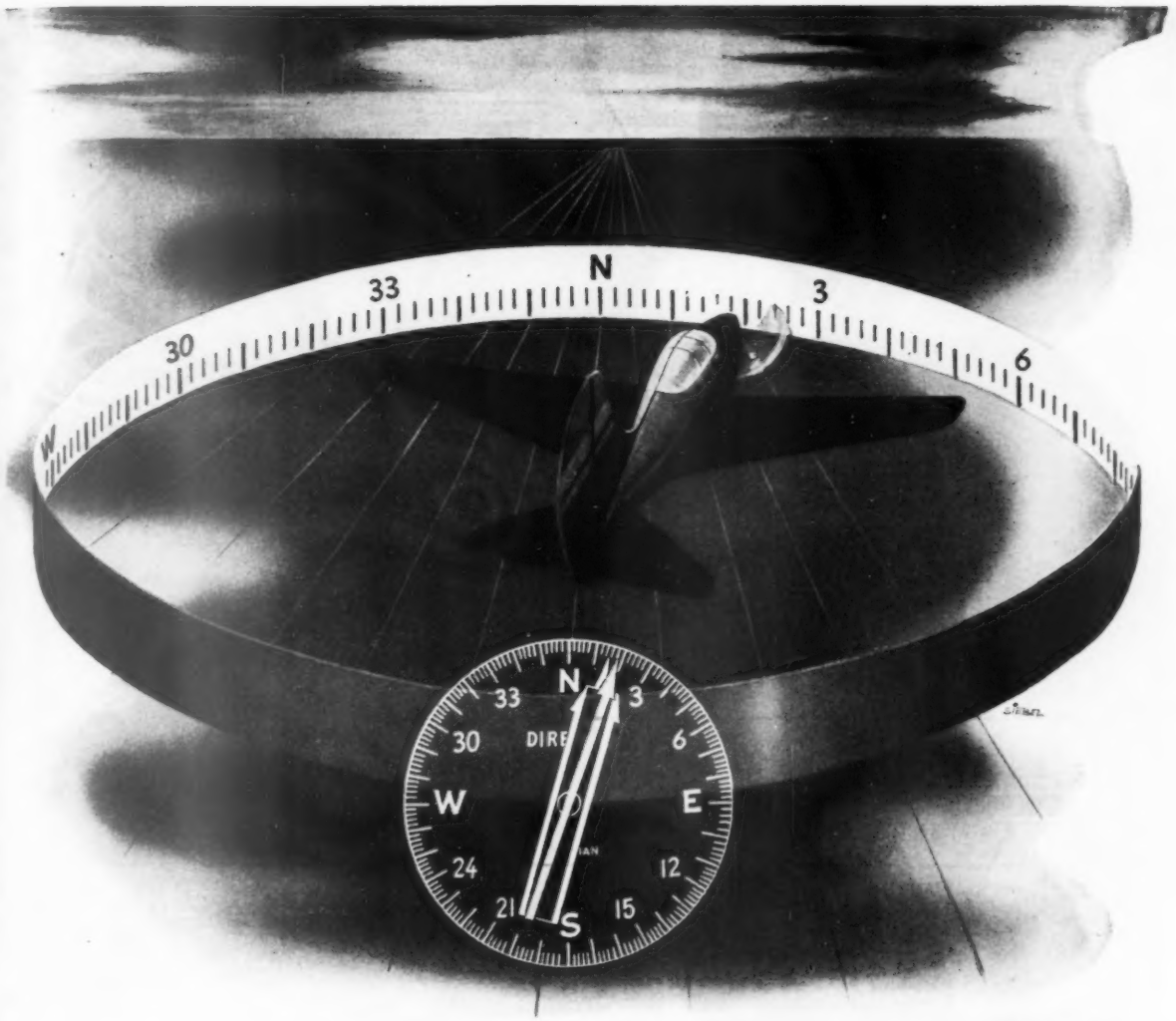
Fairchild engineering and design built these features into the "Packet":

- The ability to carry a nine-ton load in cargo or men and equipment.
- A range in excess of 3,500 miles.
- A cargo capacity of 2,312 cubic feet—about 88% of a standard boxcar's capacity.
- Space for 42 paratroopers and their equipment; rear end jump doors that deliver them "in the clear."
- Special doors in the belly, through which a paratrooper's equipment is parachuted simultaneously with his jump.
- Quick conversion to an ambulance plane capable of evacuating 34 stretcher cases with four attendants.
- Lowspeed landings and quick takeoffs from ordinary airstrips.
- Fine flying characteristics, typical of all Fairchild aircraft.
- The only modern airplane being produced to *specifically* carry cargo.

BUY U.S. WAR BONDS AND STAMPS

Fairchild Aircraft

Division of Fairchild Engine & Airplane Corporation, Hagerstown, Maryland



A Compass that Actually *Points!*

The flight-like indication of the new Kollsman Direction Indicator achieves a new realism in compass indication which has won the enthusiasm of many pilots. It exposes an entire 360° compass rose to view while its needle points the direction in which the plane is heading. Further, an index pointer is included which can be set to the desired compass course. The pilot thenceforth has only to keep the pointers matched. This new instrument is typical of Kollsman's continuous effort to make flying easier, more exact, safer . . . thereby increasing the utility and effectiveness of the airplane.

Write today for the illustrated folder describing the new Kollsman Direction Indicator. Kollsman Instrument Division, Square D Company, 80-08 45th Avenue, Elmhurst, New York.

The Kollsman Direction Indicator is self-contained, with magnetic compass element of excellent performance characteristics. Very little "overswing", exceptionally stable pointer. Mounts on instrument panel like any standard compass.

KOLLSMAN AIRCRAFT INSTRUMENTS

PRODUCT OF

SQUARE D COMPANY

ELMHURST, NEW YORK • GLENDALE, CALIFORNIA

Jack & Heintz Inc., Cleveland, O., manufacturers of

Buy More War Bonds and Stamps

SERVICE
in Seven League Boots

BORDER to border—coast to coast—wherever skilled technical service may be needed, Jack & Heintz can be on the job in 24 hours! Not satisfied with mass producing precision aircraft equipment for war, we have built up a corps of trained field experts to help with its installation and maintenance.

Since Pearl Harbor, this group of nearly a hundred specialists has done yeoman duty in keeping 'em flying for victory. Because idle planes are as profitless in peace as they are useless in war, these men can be a tremendous asset to post-war commercial aviation.

Remember, in future planning, that all Jack & Heintz products—instruments, starters, motors, generators, magnetos—are backed by nationwide service . . . in seven-league boots!

ers of aircraft engine starters, generators, gyro pilots, gyro flight instruments, magnetos, motors.

Why take a chance on "Locking Open"?

Revolutionary Crown Zipper "two-way" track makes Crown the world's safest, most dependable zipper!

What happens when an ordinary zipper comes open *behind* the slider? Often the zipper must be replaced — and sometimes the article to which it's attached.

But Crown Zippers are different. Even if the teeth *do* come apart behind the slider, there's no harm done. In two quick zips the slider can be moved backward along the track, then forward again, closing the entire track perfectly!

This is made possible by Crown's exclusive tooth construction. Both sides of each individual zipper tooth are identical, making Crown the world's *only* zipper with a smooth "two-way" track! And this is but one of *five* advantages Crown Zippers have over old-style zippers. (See complete listing below.)

That's why you can be sure that Crown Zipper applications in postwar aircraft equipment will give unfailing service—will zip smoother, further, faster, more securely!

Moreover, when you turn to postwar, Crown engineers, fresh from their experience in redesigning hundreds of military items, will adapt—or, if necessary, *create*—special zipper applications to meet special jobs.

Crown's new "double-acting" zipper provides opening wherever needed with smooth closures in both directions.

CROWN ZIPPERS are 5 ways better

1. Takes sharp curves

2. Die-cast for smoother action—extra strength

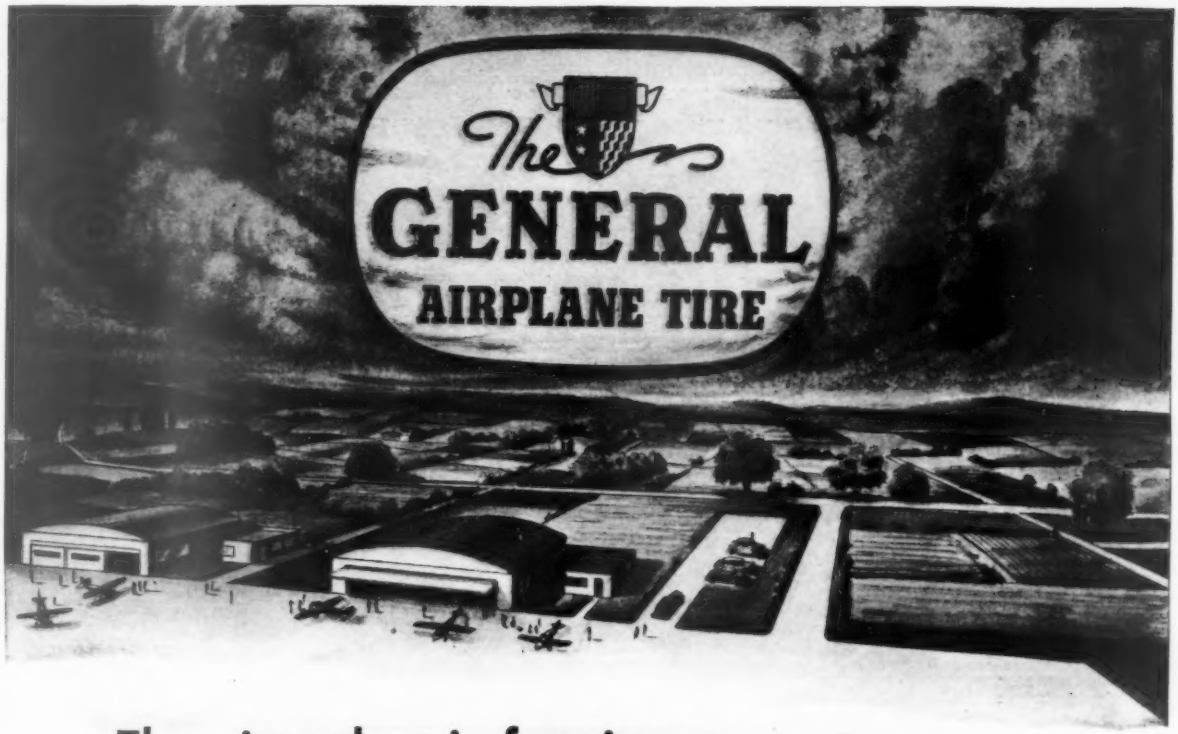
3. Provides opening wherever you want it

4. Won't lock open

5. Resists corrosion

Member of the J. & P. Coats • Clark's O N T *Family*

THE SPOOL COTTON COMPANY • *745 Fifth Avenue, New York, N. Y. (Crown Fastener Division)*



The sign that is forging a

TOP-QUALITY GROUND SERVICE NETWORK

LIKE a huge landmark on the horizon, the sign of The General Tire has grown to symbolize to flyers not only aviation's Top-Quality tires and allied products, but has also become the guide to where service and facilities are best and most reliable.

For, just as General Tires represent the finest in quality and safety, their airport outlets rank tops, too, because they have been carefully selected by General Aviation Tire Distributors to measure up to the strictest service standards.

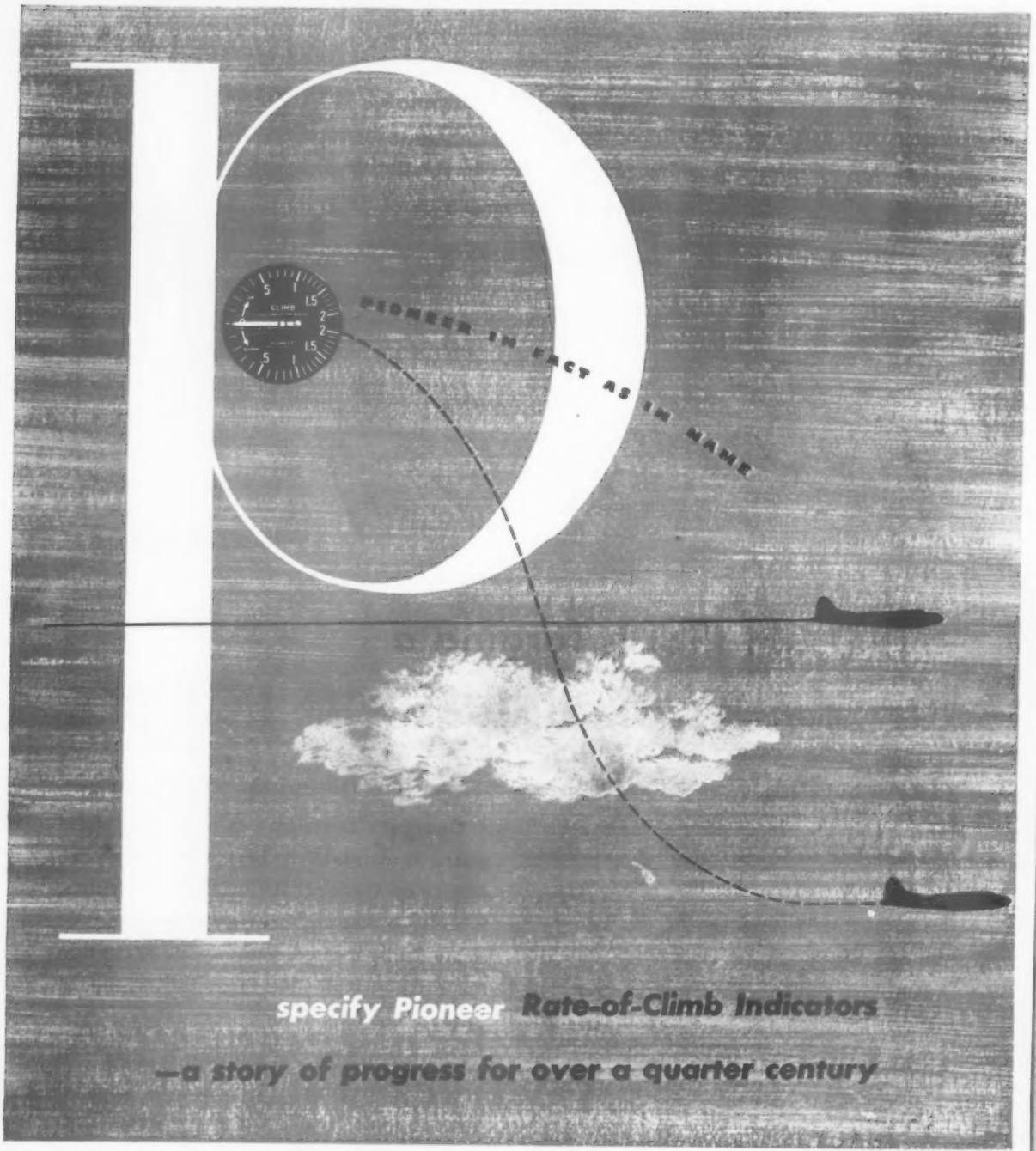
General's Distributors constantly stand guard to maintain the best possible wartime service on General Aviation Tires, tubes, wheels, brakes and accessories by means of strategically located, nation-wide stocks that serve the private flyers' ground crew—the dealers and fixed-base operators.

The ground service organization this group is forging . . . backed by General Tire's 30 year reputation for proved Top-Quality products . . . is earning a steadily growing acceptance of the General Tire Sign as the flyer's emblem of quality, service and dependability.

Unitized Landing and Auxiliary Wheels —In Matched Sets!

AVIATION DIVISION
THE GENERAL TIRE & RUBBER CO., Akron, Ohio

KNOWN ROUND THE WORLD FOR QUALITY AND SAFETY



In 1919 an instrument for measuring the rate of climb or descent of an aircraft was mounted on the panel of a U. S. Navy experimental plane at the Naval Aircraft Factory in Philadelphia. This early "thermos bottle-and-case" was Pioneer's—and the world's—first Rate-of-Climb Indicator, Type 132.

Today the Pioneer Type 1636 Rate-of-Climb Indicator, sensitively compensated for temperature and altitude changes, is specified as standard equipment for thousands of aircraft throughout the world.

This record of progress in blind-flying and instrument-approach avigation is another example of Pioneer creative engineering, ceaselessly striving for maximum reliability, accuracy, and sensitivity.

PIONEER INSTRUMENTS

Bendix and Pioneer are trademarks of Bendix Aviation Corporation

ECLIPSE-PIONEER DIVISION Bendix AVIATION CORPORATION

Teterboro, N. J.

Folks who'll fly tomorrow...

and why they will

1. "Business doesn't pound at your door when you're an investment banker. You have to go out *after* it all over the country. That's why I'll be flying my own Cessna postwar."

2. "Will college girls fly? Just watch *me.* I'll get home, or to the game, any week end I want to—not just once a semester. That's why a Cessna looms big in my postwar plans."

CHOOSE CESSNA!

Two-way Stretch for a Superfortress

These ribs for the fins of the far-flying Boeing B-29 Superforts are formed on a *giant,* 600-ton press in the big Cessna plant.

They must be bent *and* elongated a full two inches. Precision is demanded. It used to take two operations. So Cessna engineers built *new* tools for this machine. Result: It bends and stretches in *one* operation. Saves time, money, men, and vital equipment.

In addition to building nineteen important units for the B-29, Cessna also makes the mammoth landing gears and the engine cowlings for the famed Douglas A-26 Invader. In one ten-week period, 262 special precision tools were designed and built by Cessna... all to improve quality, speed production. Another good reason why you, and other thousands, will *choose safety-engineered Cessnas.*

CESSNA AIRCRAFT COMPANY, Box 1616-F, Wichita, Kansas

Cessna

SYMBOL OF AIRCRAFTSMANSHIP FOR THIRTY-FOUR YEARS

A PATENTED "ROCKING CHAIR"

BY J. FRED HENRY

Publisher of "Skyways" tells how Bell Aircraft developed a method for forming plastic cabin tops for military fighters that eliminates surface defects and improves visibility.

The patented "Rocking Chair" method was used to form the plastic cabin tops on these P-63 Kingcobras, shown here as they are being prepared for fly-away delivery to Russia over the Northern Route.

"BELL AIRCRAFT has made an impressive record in developing new methods—not only for improving the fighting performance of our war planes but also for developing many innovations which have greatly speeded up production. One outstanding example is Bell Aircraft's patented machine for molding its transparent plastic cabin tops and canopies.

"Before 1940, these cabin tops and hatches were made by manual methods, too slow for the tempo of scheduled war production. Four men had to pull a sheet of hot plastic over a cotton covered form. It took time, and impressions from the cloth sometimes appeared in the canopy, impairing clear vision.

"One day it was discovered that if there was controlled, constant movement between the plastic sheet and the mold form, many of these defects could be eliminated.

"Utilizing this principle, Bell Aircraft engineers invented, and patented, a stretch-forming machine which keeps the hot rubbery thermoplastic in constant motion—rocking the form until the sheet of material has reached its proper contour and cooled to its final shape.

"This ingenious mechanical 'rocking chair' turns out plastic cabin tops which are not only accurate in form but also of greatly improved optic quality. By the patented Bell Aircraft method a finished clear top comes off the 'stretcher' every seven minutes and two girls are the sole operators.

"They say that necessity is the mother of invention. During this war, Bell engineers have developed many other time and labor-saving ideas which, like the patented 'rocking chair' have helped advance aeronautical science by decades, making possible improved manufacturing methods not only for war but for peacetime production as well."

★ *Buy War Bonds and Speed Victory* ★

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL...EAST COAST, INC.

BELL *Aircraft*

PACEMAKER OF AVIATION PROGRESS

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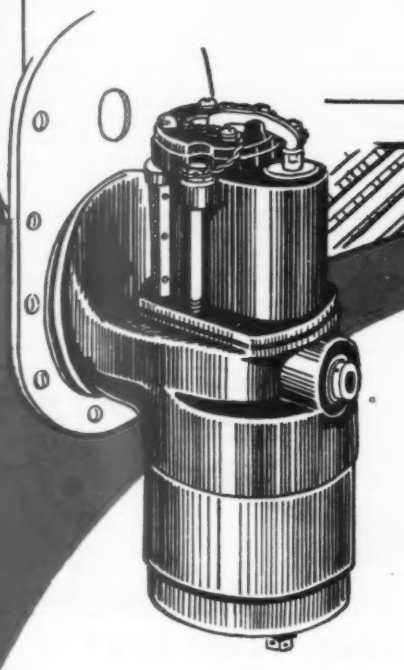
WATCH

for the April Announcement of

A *Fully Submerged*

WATER INJECTION PUMP

by Romec



You have a surprise coming in our April announcement. True to ROMEC tradition, we will announce another ROMEC *First*. That will be a fully submerged Water Injection Pump. A year ago, this was merely an aim. Now it becomes a reality.

ROMEC precision aircraft pumps pioneered in the first "round the world" flights, pioneered the non-pulsating rotor principle, high altitude booster pumps, hydraulic pumps, and the solution to corrosion in water injection systems. Write today if you want us to mail you a copy of the April announcement on the fully submerged ROMEC Water Injection Pump.

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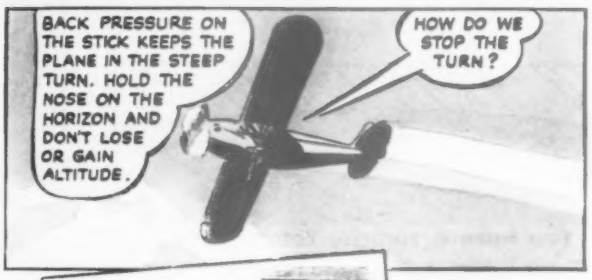
BACK PRESSURE ON THE STICK KEEPS THE PLANE IN THE STEEP TURN. HOLD THE NOSE ON THE HORIZON AND DON'T LOSE OR GAIN ALTITUDE.
HOW DO WE STOP THE TURN?

WE RELEASE BACK PRESSURE, MOVE THE STICK LEFT AND PRESS LEFT RUDDER. NOW WE'RE FLYING STRAIGHT, SO WE RETURN THE CONTROLS TO NEUTRAL.

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New booklet, "How to Fly a Piper Cub", covers the fundamentals of flying with over 50 step-by-step photos and descriptions. Many other facts, full-color pictures of Piper Cubs. Send 10c in stamps or coin for postage-handling. Write Piper Aircraft Corp., Dept. PA45, Lock Haven, Penna.

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   Less than ten dollars.
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This lesson and others that will follow explain only the fundamentals. See your Piper Cub dealer for actual flying instruction. Write us "Plane Quiz" questions you want answered.

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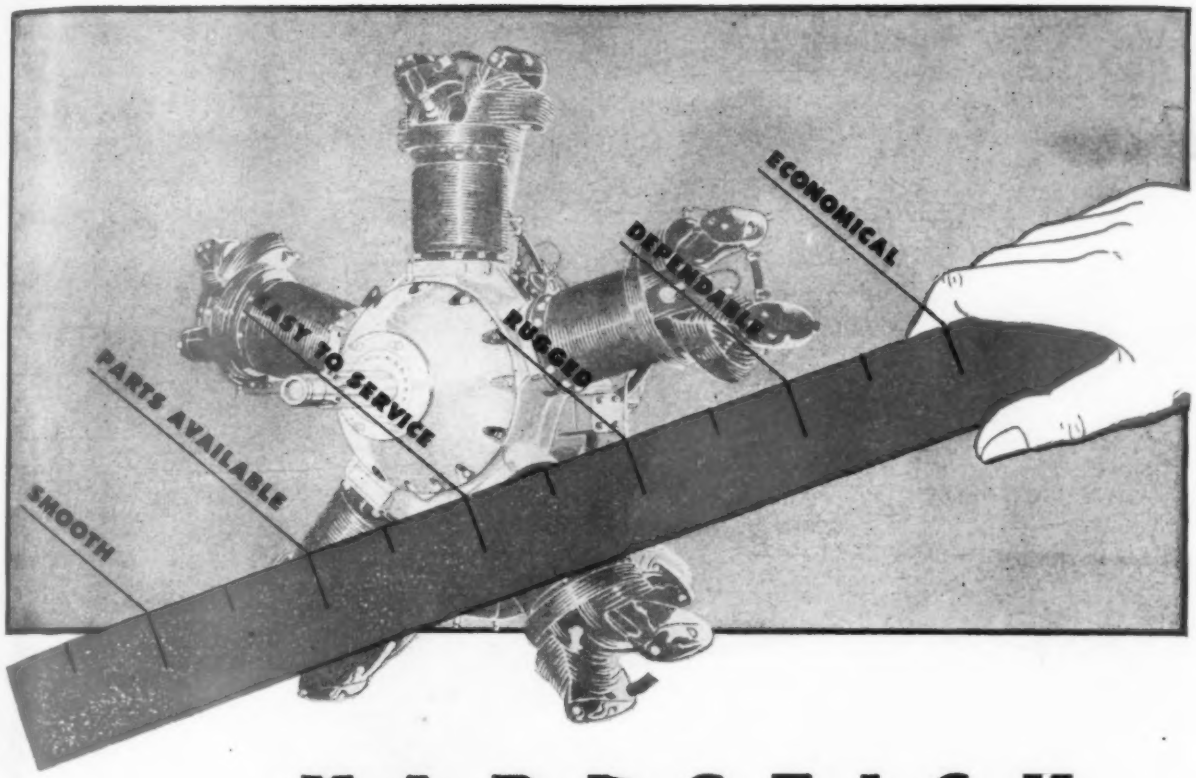
PIPER CUB

Points the Way to Wings for ALL Americans



YARDSTICK

for Fledglings . . . . .

Come V-J day, hundreds of thousands of fledglings are going to get into the sky—for business and for fun. Whether they fly their own, or an operator's plane, they'll want to know—

Is the engine: **DEPENDABLE . . . ECONOMICAL . . . POWERFUL . . . RUGGED . . . SERVICEABLE . . .**

Apply these yardsticks to Kinner—look at the Kinner record.

Kinner for a quarter century has built dependable, economical engines that have given millions of hours of trouble-free flying to owners and operators. Thousands of today's "hot" fighter and bomber pilots got their first training behind Kinners. Kinners have ample reserve power for take-off and emergency; they are rugged—built to stand up to punishment. And, Kinners are designed for easy servicing and checking. Kinner parts and service are *always* available; no Kinner has ever been "orphaned." Specify Kinner in the plane you fly—come V-J day.

KINNER MOTORS, INC., GLENDALE 4, CALIFORNIA

BUY WAR BONDS

Kinner

1919—BUILDERS OF DEPENDABLE AIRCRAFT ENGINES FOR OVER A QUARTER CENTURY—1945

Finish the Fight — with War Bonds

Coast-to-coast record: 6 hrs., 3 min., 50 sec.

It's 11:38 o'clock in Seattle on the morning of January 9, 1945. A new Boeing giant of the skies—the C-97 Army transport—lifts into the air and heads east.

One hour—up 30,000 feet and smooth sailing. Two hours — 45 below outside, warm and comfortable inside. Three hours—high above storms over the Dakotas. Four hours—the mighty Mississippi *far* below. Five hours—over Ohio.

Six hours—3 minutes—50 seconds—and the big ship arrives in Washington, D. C. . . . 2323 miles at an average speed of 383 miles an hour with tail winds averaging about 45 mph . . . a new coast-to-coast record!

Behind this historic flight is the bright blue-print of a new era in air travel. For the C-97 transport is the military forerunner of the great post-war luxury airliner—the Boeing Stratocruiser.

With the advent of this new supertransport, the rosy promises of tomorrow's aviation become realities. You'll lunch in the East, dine on the West Coast. You'll travel in luxurious comfort, and at surprisingly low cost.

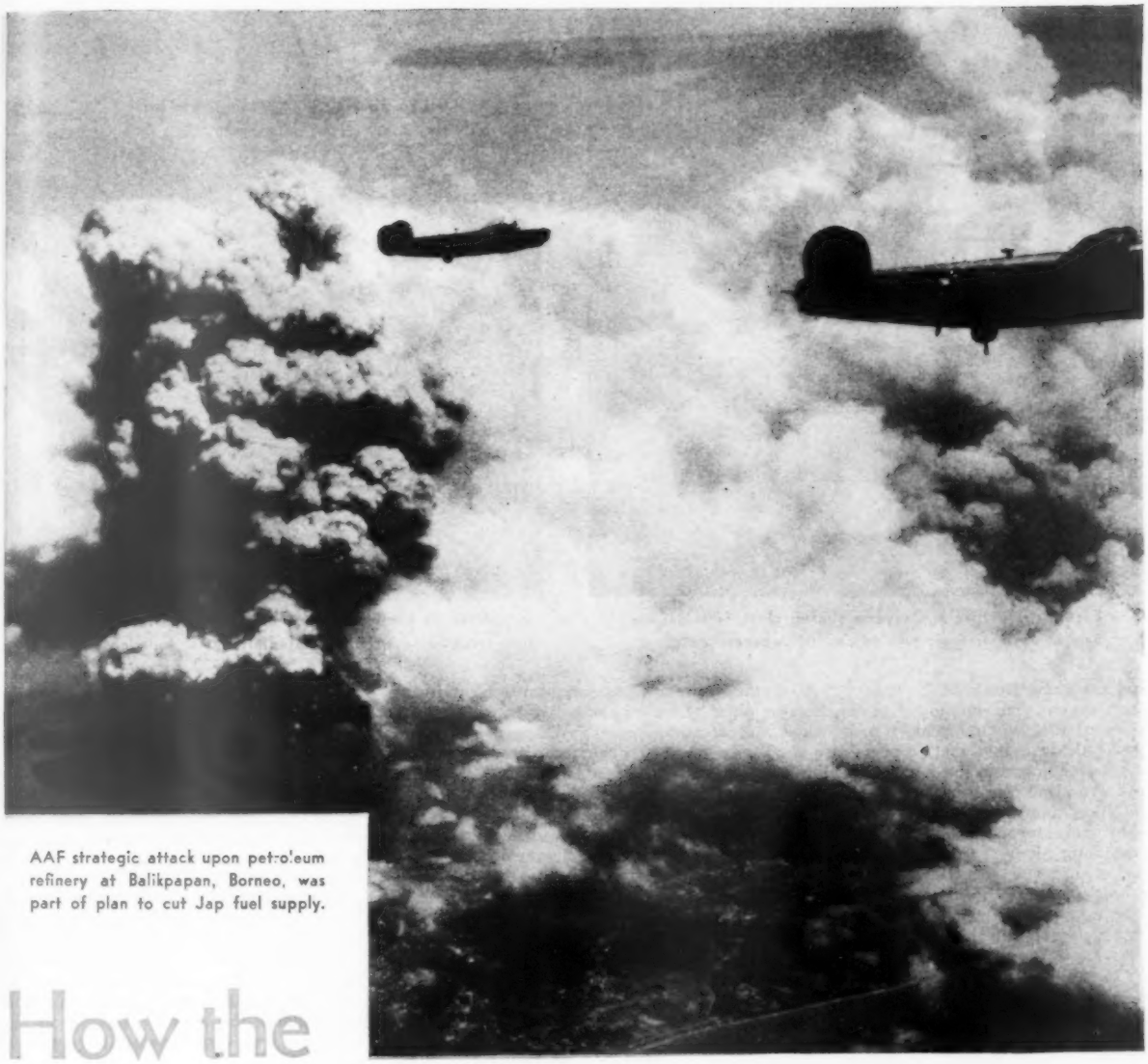
A huge double-deck, four-engine airplane, capable of carrying up to 100 persons, the Boeing Stratocruiser will have operating ranges up to 3500 miles with ample fuel reserves. When flying at over-weather altitudes, atmospheric conditions inside the pressurized cabin will be equivalent to comfortable low-level flight.

The Boeing Stratocruiser is the newest member of a famous family of four-engine champions. The aerodynamic advancements built into this big ship have been thoroughly war-tested in the B-29 Superfortress, and are the result of long experience in the design and development of the Boeing Flying Fortress, Stratoliner and Clipper. The record-breaking performance of the C-97 offers striking evidence of what you may expect from this new Boeing airliner.

When victory is won, the same skill in design, engineering and manufacture which has established Boeing leadership in the big bomber field will bring you the Stratocruiser and other advancements in air transport. You can be sure . . . if it's "Built by Boeing" it's out in front.

DESIGNERS OF THE B-29 SUPERFORTRESS • THE FLYING FORTRESS • THE NEW STRATOCRUISER
THE KAYDET TRAINER • THE STRATOLINER • PAN AMERICAN CLIPPERS

BOEING



AAF strategic attack upon petroleum refinery at Balikpapan, Borneo, was part of plan to cut Jap fuel supply.

How the AAF Uses Air Power

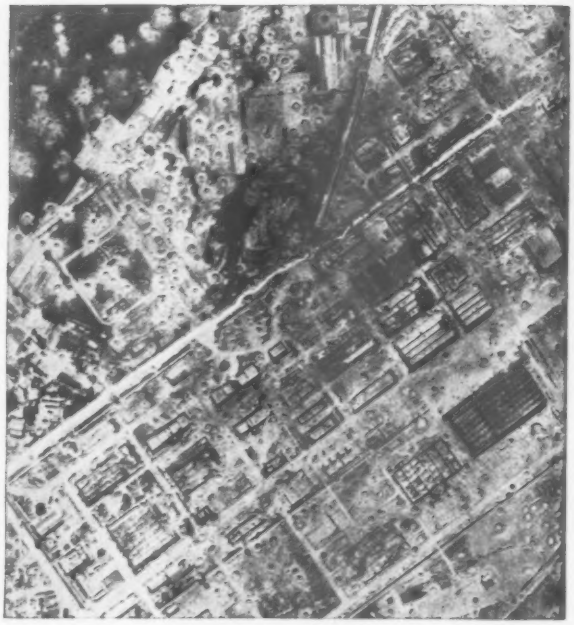
By Brig. Gen. WILLIAM W. WELSH

Our aviation aims at enemy's industry, air forces, supply, and finally his ground troops.

THE true relationship between air power and land and sea forces is perhaps one of the most poorly comprehended factors in the complex pattern of modern warfare. This lack of popular understanding stems from the relatively brief history of modern concepts of aerial warfare in comparison with the classical theories of land and sea fighting, and also from the fact that the contribution of air power, to a greater degree than that of other branches of the service, must await cessation of hostilities in any given theater before it can be completely evaluated. Or perhaps it might better be said that final analysis of air power's part in winning the war will be fully established only with the coming of final victory and peace.

Such a lack of understanding gives rise, from time to time, to certain specific questions which indicate a need for restatement and clarification of the basic principles underlying the use of air power by the United Nations in their struggle against the Axis. Is it true, as some critics have indicated, that too much emphasis has been placed on air power in U. S. military strategy? Or is the truth at the other extreme—that aviation and aviation alone can win the war and everything else should be subordinated to it? Why hasn't our aerial firepower been concentrated where the fighting is, instead of being divided between the war fronts

Superfortress strike at Okayama aircraft plant, Formosa, was part of AAF strategic plan to destroy Japanese air power.



After the bombing only 37 of 80 buildings remained. A second attack two days later left only six buildings intact.

and the home fronts of the enemy? Was the German plan, employed in the blitzkrieg of 1941 when France was knocked out of the war in a matter of weeks, the more economical in the light of casualties and overall expenditures?

Rather than attempt to answer such questions categorically, let us examine the basic objectives in our struggle against the enemy and see where and how air power enters the picture.

In all warfare there are two zones to be considered, the enemy's front lines and his zone of the interior on which he must depend for arms, ammunition, and supplies. Linking these two zones are lines of communication. Wherever the army goes, it must not outrun its communication system nor must it allow this communication system to be severed or it is defeated before the battle is begun. These facts are, of course, self-evident. The classic land and sea maneuvers by which we seek to strike at the enemy's front, his zone of the interior and his lines of communication are common knowledge: we push the enemy back from his forward position, we seek to outflank him and get to his rear, cutting off his communications system. The third possible objective, to strike at his zone of the interior itself, would, in the days before air power, ordinarily remain a theory only because by the time we had been able to break through his forward lines sufficiently to reach his sources of supply and power the conflict would already have been finished.

In World War I, the last major struggle in which air power did not play a decisive part, the plan of campaign proceeded along these lines. Both sides, however, were able to move with approximately the same speed and strength and each sought to outflank the other. The result, inevitably, was a stalemate—four years of trench-fighting on the western front—which resolved themselves into a war of attrition. This was ended when the Allies finally succeeded in bludgeoning their way through the weakened Central Powers to final victory.

Now let us examine the opposing forces again drawn up in World War II—this time with all the elements of mechanized warfare. Let us suppose that the enemy is planning an offensive in a certain theater. What do these plans involve?

First, they mean that he must procure a certain quantity of planes, tanks, trucks, artillery, and all the other mechanized weapons which will be necessary. He must procure troops. He must procure fuel, ammunition, food, and repair units—everything that is needed to operate such an enterprise. This first step in planning involves factors *in the zone of the interior.*

What is the next step the enemy must

One way to knock out air power is to destroy runways and airfields. This is Tanchuk air base on West River in Kwangsi province, China, now in Japanese hands.

Flying veteran of the First World War, the author joined the regular army in 1920. He has been assistant chief of air staff, training, at AAF headquarters since September, last year.

take in order to carry out a successful offensive? Having procured these troops, arms, and supplies, he must move them forward into the battle area. This obviously involves *lines of communication*—waterways, railroads, highways, bridges. Having moved them into the battle zone, he must build ammunition dumps, set up supply depots, field service units, and whatever else is necessary to base his troops and keep them functioning during their operations.

The third step is, of course, the actual operation—moving troops into position for the offensive, together with mobile units in service and supply them.

How does air power enter this complicated picture?

Let us go back to the first step of enemy planning involving the zone of the interior. The keystone of this structure of military planning is *production*. It is at the enemy's production that strategic air power strikes.

Much has been written about the function of strategic air power, especially during the great aerial offensive over Europe in the months which preceded the Normandy invasion. Yet strategic bombardment is one of the most difficult operations to make clear to the general public, chiefly because its mission is a long-time one. Its results cannot be completely evaluated until after the cessation of hostilities, when we are able to obtain final, eyewitness proof of the destruction of vital Nazi industry wrought by strategic bombardment of the Allied Air Forces.

Another difficulty in the way of understanding strategic bombardment is the choice of targets. Sometimes the reasons for their choice are apparent to the layman and sometimes they are not. Allied attacks on the Ploesti oil refineries, for example, were more immediately understood than the great raids on Schweinfurt and other ball-bearing manufacturing centers. Why was ball-bearing production chosen rather than such an obvious base of war material as iron or steel?

It was because an attempt to wipe out

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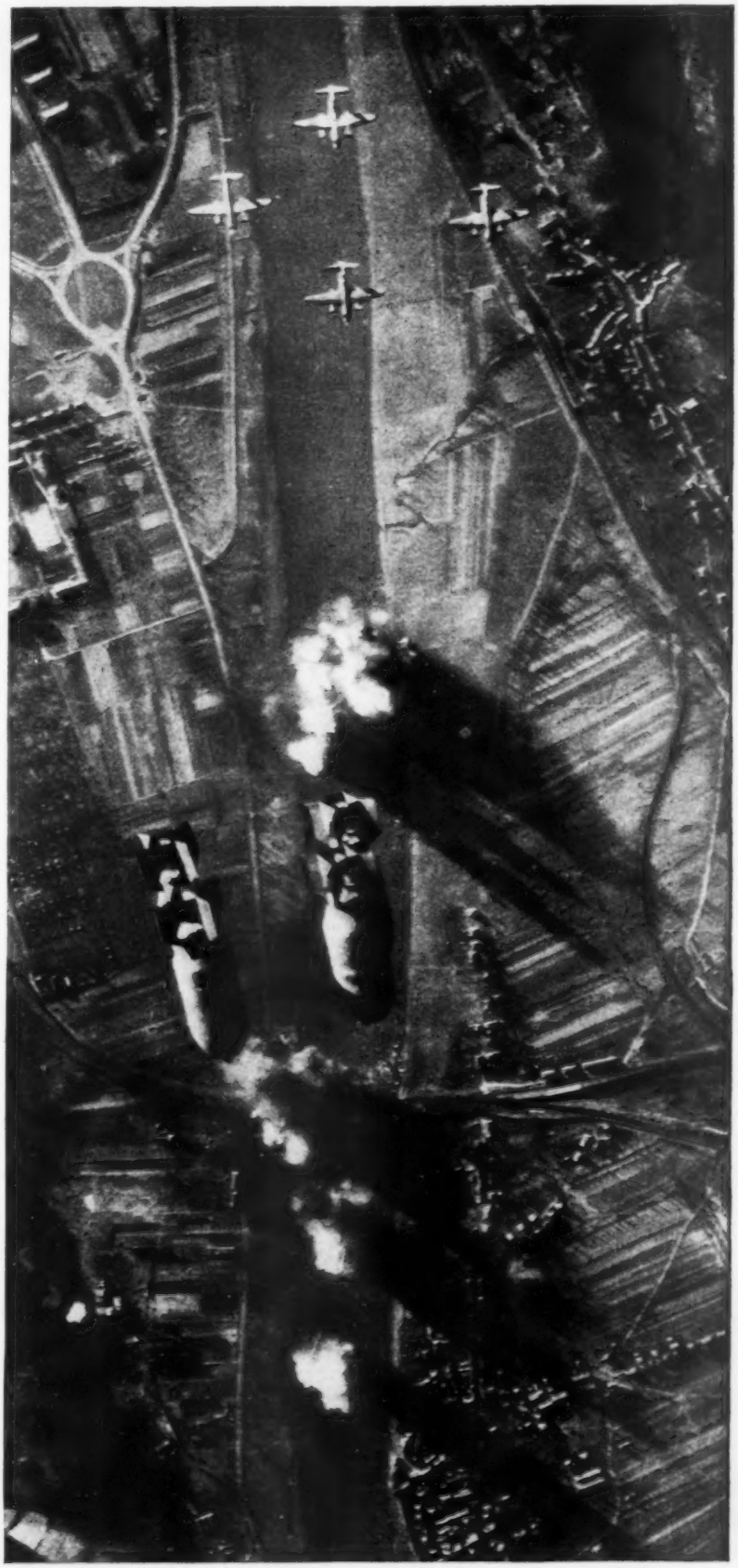

Ninth Air Force Marauders bomb Moselle River bridge north of Trier, Germany, in concerted effort to isolate German army units from their supply sources in rear.

OUR PLAN FOR

The new Civil Aeronautics Administrator outlines a positive six-point program for encouraging post-war private flying.

IF THERE is going to be mass private flying after the war, Government and the industry must do more than merely talk about it. They must begin to do a number of fundamental things without which it cannot be brought about.

That is the way we are winning the war in the air. We did not drag our heels, say that a 50,000-a-year-plane production was impossible, and build planes that seemed fine to the industry but not to the men that flew them. We are winning the war in the air because we tightened our belts and went to work, considered nothing impossible, and built planes for the customer—pilots at the fighting fronts.

We must attack our post-war problems in the same fashion. If we do not, civil aviation will be in grave danger of backsliding from a mass industry to a small exclusive operation in the luxury field.

I say "civil aviation"—in this I include Federal agencies having to do with the problem as well as private industry. The two should be considered as one because they must act as one. They must be a team. Aviation cannot fly profitably and successfully without these two wings of support in the post-war years.

And it cannot operate profitably unless we resolve a number of things mutually, lay down, perhaps, a platform or set of rules for post-war private flying. Maybe half a dozen is not enough, but you can add others as you desire:

1. Just as we are going to any length to please the wartime customer—the frontline pilot—so must we extend ourselves to meet the needs and the demands of the post-war mass market customer.

The CAA Program

1. More Acceptable Planes
2. More Airports
3. Simpler Regulations
4. Public Training Program
5. Consumer Sales Program
6. Better, Cheaper Planes

2. Airports—airparks—must be built in great numbers, and close to town.

3. Regulations must be rationalized and put in understandable language.

4. Private flying must be encouraged by a revival of some such activity as the old Civilian Pilot Training Program.

5. We must prepare for a fight with stiff competition. People are going to want to buy houses, iceboxes and automobiles after the war, as well as airplanes. Aviation enthusiasts—in Government and in private enterprise—must quit selling the airplane to each other and begin to sell it to the general public.

6. And above all—the most important plank in the platform—we must develop a private flyer's airplane vastly superior and less costly than any now known—an airplane worthy of the most discriminating market.

As the Government agency required not only to foster the growth of the aviation industry but to protect the people's investment in it, the CAA is standing on this program with the intention of doing all in our power to fulfill it. So far, we have heard little criticism against it except in respect to the development of a more practical, safer family-type airplane. Let me make it clear now that we have no intention of going into the manufacturing business. *We do intend to contract for the development and improvement of certain features for private aircraft that statistics show will sell more airplanes and thus benefit the manufacturers and the flying public of this country.*

We are not alone in this—in private in-

With a Cub on stage, high school students study aeronautics. CAA encourages such education.

Airplanes must have a place to land, hence

PRIVATE FLYING

By T. P. WRIGHT

Administrator,
Civil Aeronautics Administration

dustry similar developments are underway and scores of aviation leaders with whom I have talked long since have subscribed wholeheartedly to the six points cited above, plus more of their own. But unless and until the entire industry faces its post-war problems in an aggressive, affirmative fashion, we will fall so far short of our goal.

In saying this I am not one of the million-planes-a-year prophets seen too often these days in the headlines on the post-war world. I am advocating simply a healthy, normal, peacetime industry that will show a healthy, normal rate of growth.

There will be some 30,000 civil licensed aircraft in the United States on VE-day. If production of present model planes is resumed at that time, and if we are permitted to proceed with our airport, pilot training and regulation relaxation programs, then I think the number of such planes will increase at the rate of about 30 per cent a year until a top of 75,000 is reached, after which it will stay stationary. At that rate it will take about 3½ years to reach our 75,000 maximum of privately-owned aircraft.

But if, on the other hand, manufacturers are in production by the end of that 3½ years on airplanes that fit the minimum post-war mass market standards, I believe the number of planes will continue to increase at the rate of about 30 per cent per year up to about 400,000.

Let's face it: great as past progress has been in airplane and engine design, our present planes are too expensive and lacking in utility and safety features to be widely accepted as a family mode of transportation. Experience with automobiles shows that the popular plane must accommodate the whole family, which means it must seat at least four persons. To effect a real saving in time over long distance auto travel, it should cruise at three times the speed of the family car, or about 150 m.p.h. It must be inherently a safe airplane and simple to operate. And this is very important: the price must be brought down to $2,500 or less.

Furthermore, and this involves our airport construction plans, crosswind landing gear must be developed so that an adequate number of landing fields can be built, at reasonable public cost, to bring aviation close to home.

If industry does not take the initiative in developing an undercarriage that will permit crosswind landings, the CAA will sponsor it in the public interest. With a projected Federal Government investment of $1,250,000,000 in airports, it will be worthwhile to spend a considerable sum making it possible for planes to land regardless of wind direction on a one-runway field. By making the standard airport for family planes with one runway, instead of two or three, we can save approximately 50 per cent of the cost of each such landing field and build double the number of them with the same amount of money.

I believe the public expects at least these features in the planes it hopes to own after the war, and that they are all well within reach of our ability. I have not yet mentioned the possibilities of roadable planes, or of rocket and jet power, which undoubtedly are going to influence even lightplanes sometime in the future. I am thinking only in terms of the 10 years immediately following the war and of what we know from experience is practicable. There are almost no limits to the potentialities private flying holds. Perhaps rotary wing aircraft, now

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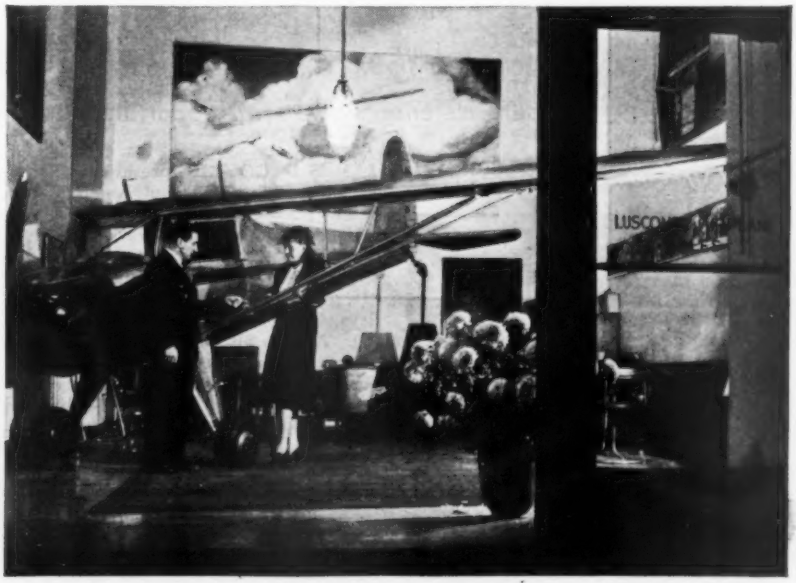
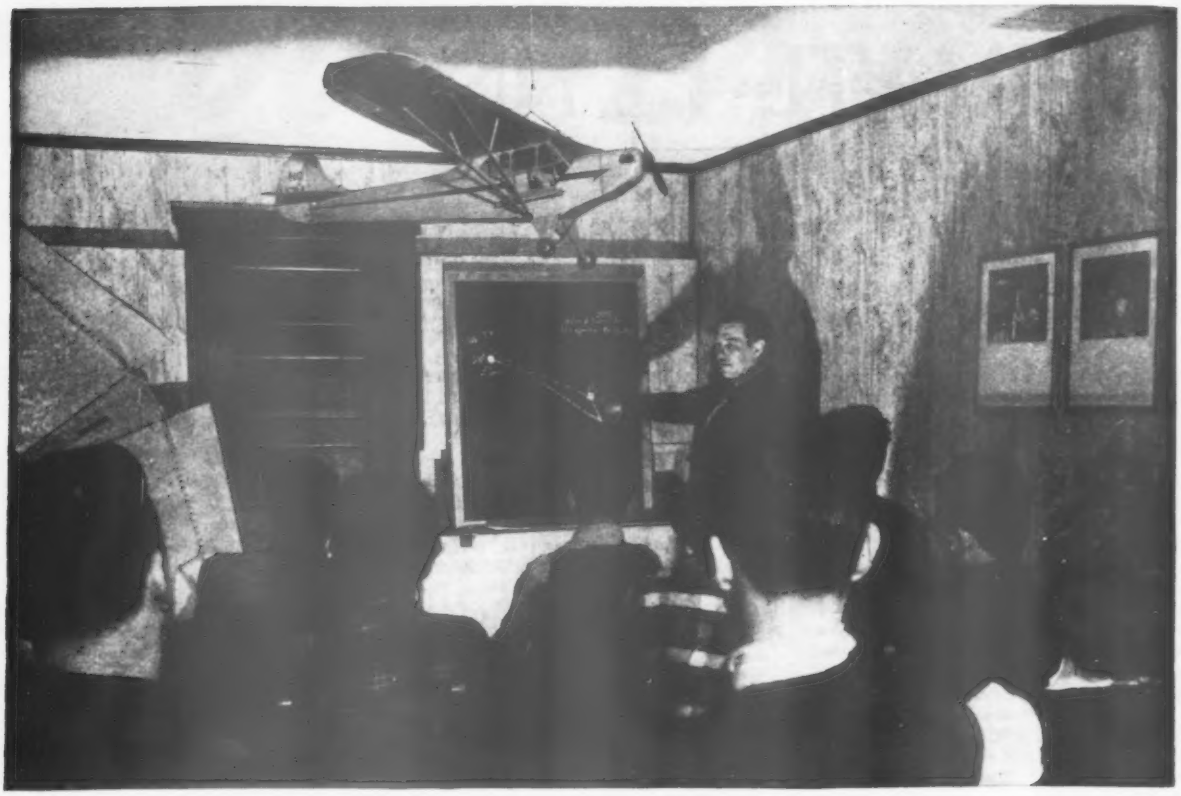
must be simple, numerous and accessible.



There must be a sales plan. Planes will have to compete with cars, refrigerators, houses.



In addition to flight training, club members are given weekly class instruction in navigation, meteorology and CAR by certificated instructors.

War Workers' Flying Club

By LAWRENCE KEIL

Associate Editor of FLYING

Here is a flying club that is succeeding. Its purpose is to assure defense workers an opportunity to fly economically.

James Goggin (left), and Wendell Hill, who organized the original Douglas Flying Club.

JAMES D. GOGGIN, president of Associated Flying Clubs of America, Inc., and a supervisor in the Douglas Aircraft Company plant in Park Ridge, Ill., one day felt the old urge to get back into an airplane, fasten his safety belt and get going. A veteran of barnstorming days, Goggin well knew the costs of flying. And he also knew that around him were hundreds of potential private flyers, busily assembling, welding and riveting the giant Douglas *Skymasters*. Such were his remarks one day when "talking shop" with a group of Douglas workers in the plant cafeteria. Mention of a flying club Goggin had formed in Virginia in 1934 brought the query, "why don't we start one here?" Thus in July, 1943, the Douglas Flying Club, Inc., was born operating on a not-for-profit basis and dedicated to providing economical flying to a greater number of people than ever before.

Prospective members were told that their $25 initiation fees and monthly dues of $2 would be accumulated until a suitable plane could be purchased for cash. Hence, months went by before the nucleus of this group actually began flight operations. As membership grew, additional lightplanes were acquired, until four small trainers comprised the club's fleet in September, 1944.

Expanding this not-for-profit theory led Goggin and Wendell Hill, vice-president, and a small group who had devoted all their spare time to guiding the young club to reach out and embrace a number of other groups which, like Douglas' embryo pilots, had formed small clubs of their own.

The Chicago area student pilot flying clubs from the Magnaflux Corp., Western Electric Co. (Hawthorne Plant), Motorola Radio and the Arlington Flying Club

were merged with the Douglas club. The combination was given the somewhat grandiose name of "Associated Flying Clubs of America, Inc."

Goggin states that this unity was desirable from all points of view; the members realized the strength developed from a solid organization and the companies and corporations employing the club members in general welcomed the absorption since it separated the company from any responsibility, yet provided flight opportunities and social activities for their employees.

Out of this combination of clubs has grown a strong organization of 300 members, employing two full-time instructors and flying seven airplanes an average of 25 hours each per week. The experiences gained in operating a club on so large a scale are of considerable value to existing clubs or would-be clubs.

The main base of operations for Associated Flying Clubs is located at Pal-Waukee airport, northwest of Chicago, but another scene of activity is the Harlem airport on the southern fringe of the city. Here Negro club members have their own instructors. To date, 116 club members have successfully soloed from these two fields. The club's seven planes are Piper *Cub* J-3 trainers with 65-h.p. engines.

Successful development of such an active club has not been easy, says Goggin. It requires fullest consideration for and close, harmonious co-operation with the fixed base operator.

Based on his experience, Goggin has sound advice for all would-be organizers of flying clubs. First of all, he warns, consider for membership only individuals whose sincerity and interest is unchallenged. Those with "show-off" tendencies might at some time give vent to their cockiness and suffer unwarranted and needless injury. Aside from the tragedy of a crash, the damage done to the club's reputation and that of the airport in general, could have far-reaching results.

Also watch for any tendency of members to capitalize on the club's facilities or equipment for personal gain, Goggin cautions. Any person who, after acquiring a private license, is found to be "selling" rides on the pretext of "giving a

(*Continued on page* 118)

At Chicago's south side Harlem airport, home base for Negro students, members have their own instructors. Above, a student is being shown the correct way to "prop" lightplane.

Instructress Sally Duncan and Flight Director "Bill" Clark view collars ripped off shirts of students who had accomplished first solo flight; 116 collars now adorn clubhouse wall.

Training planes lined up for inspection at Pal-Waukee airport are busy throughout year. Ski equipment permits winter flying.

CURE for STALLS

By E. JAY DOHERTY

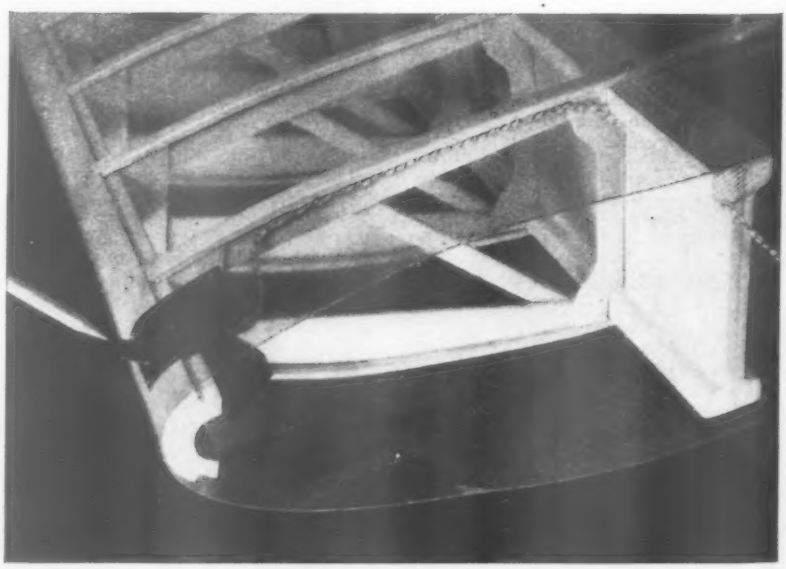
The greatest cause of flying accidents—the stall and spin—is being licked by mechanical devices which warn the pilot that a stall is imminent.

IN THE technical development division of the Civil Aeronautics Administration there is a proven stall-warning gadget that's so simple you'll kick yourself for not having thought of it. It weighs less than two pounds and though part of it is installed in the leading edge of the wing it creates a negligible amount of drag.

The day this gadget or another nearly as simple becomes available commercially —and that should be soon—will mark the beginning of the end of most stall accidents. And that will mean much more than a reduction of fatalities. Any marked reduction in the number of accidents will likewise reduce insurance premiums; it will mean fewer black eyes for aviation and wider public acceptance. All this adds up to more planes, more spare parts, more gasoline—and lower prices. So this gadget is worth looking into.

Stall accidents have been killing pilots and passengers since man first started flying. You can run through the records for 1944 and find any number of examples. Experience, it seems, is no guarantee of immunity, nor is age. And there is nothing unusual about the record for 1944. The problem has been recognized by engineers since 1918 when the first stall-warning device was patented. Five minutes of research in the patent office in Washington will suffice to bring at least a dozen more to life.

The CAA itself has been working on devices to warn pilots of impending stalls since 1941. The basis for the CAA's simplest contrivance goes into aerodynamic



Pressure change on vane of warning device (at pencil tip) trips switch when wing nears stall.

and physical principles that should be old stuff for pilots. The finished product, which has been tested extensively and declared satisfactory, blows a horn and lights a warning flash in the cockpit when a stall is imminent. Not just a toot and a wink, but a continuous blare and glare that nobody could ignore.

The device consists of a vane—perhaps ⅛ inch thick, ½ inch long and ⅜ inch wide—protruding from the leading edge of one airfoil, midway between wingtip and fuselage. It is connected with an electrical switch of standard design contained within the wing and wired to the horn and light in the cockpit. At a predetermined point before the stall, air pressure moves the vane minutely. It makes a contact in the switch and the pilot is immediately startled into action by the insistent note of the horn.

Actually, the CAA has had three developmental programs under way on stall warning indicators. The vane-actuated device described above was developed with the help of the W. & L. E. Gurley Company of Troy, N. Y. Another instrument operates on a diaphragm-switch arrangement energized by the change from pressure to suction on the upper surface of the leading edge as the angle of attack is changed. The third project is still not completed. It is an instrument that depends upon the changed character of the airflow over the upper surface of the airfoil to give its warning.

The vane device was originally proposed by Dr. Leonard Greene and has been refined to its barest essentials under the direction of H. R. Larsen, chief engineer of the Gurley company. The CAA also credits Prof. A. J. Fairbanks of Rensselaer Polytechnic Institute for the wind tunnel testing. One of its biggest sales points—aside from the safety factor—is its low cost in comparison with standard aircraft instruments. Although it is not yet on

(*Continued on page* 130)

Pieces of string attached to leading edge indicate change of airflow when nearing a stall.

When airplane approaches a stall, the CAA-Gurley indicator lights up and blows a horn.

Component parts of stall-warning indicator are (left to right) a power supply, audio-visual instrument and leading edge vane.

BLUEPRINT
For a State Air Department

By L. L. SCHROEDER
Commissioner, Minnesota Department of Aeronautics

A partisan for the states outlines his ideas on aviation controls in the state-Federal controversy.

THE year 1945 finds the 79th Congress and 44 state legislatures in session and civil aviation poised on the brink of a bright but unknown future. All of these legislative bodies will consider the enactment of laws relating to aviation. The pending bills already before Congress indicate that some source at the national level believes that aviation's problems can be handled only by the absolute control of a Federal bureau.

The answers which lawmakers, jurists and legal theorists now seek must come from the aircraft itself as civil aviation develops. That no one knows just what this pattern may be is obvious to any student of aviation's history.

Much of the difficulty arises from the constant effort to compare the airplane with other forms of transportation and communication. It has points in common with these forms but it is none of these. Nor is aviation like the radio merely because it uses the air space. It has its own special identity. No matter how we dilute the meaning of the "commerce clause" of our Federal constitution, we must eventually put these theories aside and return to the aircraft for directional thinking.

Where, then, can we begin to approach the Governmental problems of the aircraft? We should appreciate the danger of attempts at universal thinking with an instrument so flexible in its uses as the aircraft. The most common example of faulty logic in this sense is repeated almost daily, and the form of the syllogism is as follows:

Airplanes can cross state lines in the matter of minutes.

Mr. Piper's *Cub* is an airplane.

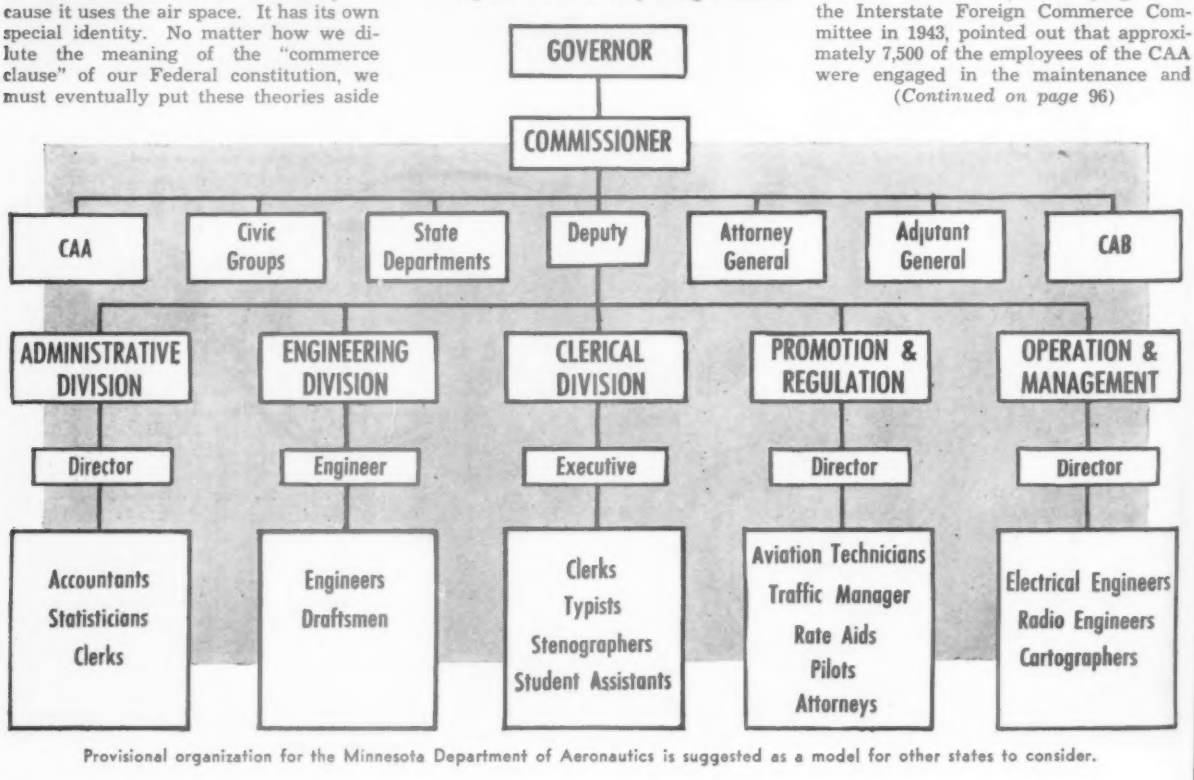
Therefore, the *Cub* can cross state lines in the matter of minutes.

With all due respect to Mr. Piper, the thousands of light aircraft which we hope will be flying in this air age will have no more in common with the transport airliner than the outboard motorboat has with the Queen Mary. Once we are able to recognize that the only thing common to all is the use of the air space when in flight, we are in a better position to examine, not the "rights," but the responsibilities and duties of the several states.

To the layman, who views aviation as being composed of four essential ingredients, (1) aircraft, (2) the pilot, (3) the air space, and (4) the landing area, it would seem that there was an immediate and simple answer. The use of the air space suggests at once the need for a high degree of Federal control. The Civil Aeronautics Administration already controls the airman and the aircraft. The airport is a local municipal problem, so why not let it rest where it is and let the Federal Government and the municipality handle aviation? Perhaps it could be done but there are some very practical barriers which become evident the moment the aircraft begin to fly.

William A. Burden, Assistant Secretary of Commerce for Air, in testifying before the Interstate Foreign Commerce Committee in 1943, pointed out that approximately 7,500 of the employees of the CAA were engaged in the maintenance and

(*Continued on page* 96)



Provisional organization for the Minnesota Department of Aeronautics is suggested as a model for other states to consider.

HOW FAST IS FAST?

As aircraft approach sonic speeds, velocities must be measured, not in miles per hour, but in "Mach number."

By GILBERT C. CLOSE

DEVELOPMENTS in aviation have followed each other in such rapid sequence since the outbreak of World War II that the average person has had difficulty keeping abreast of them. Certain of these developments, and especially those contributing to greater air speeds, have uncovered problems that make even experienced engineers stop, think, and wonder what will happen next.

Their biggest problem is one known as compressibility, which means in plain words that an object has reached a point of speed where air actually piles up in front of it and holds it back.

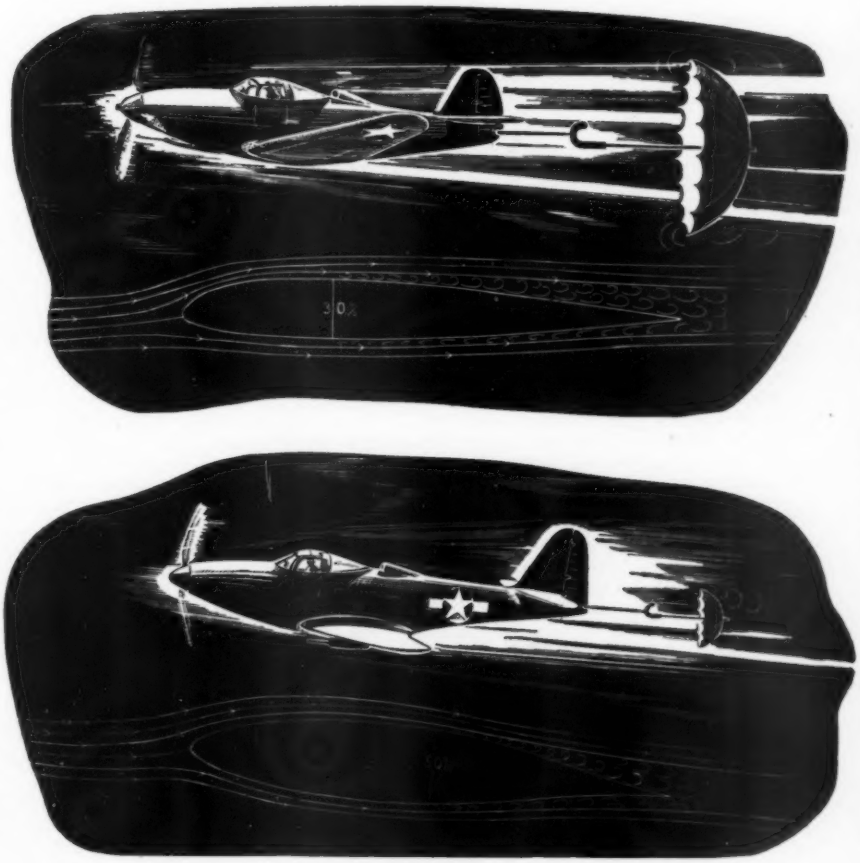
In tackling the compressibility problem, engineers have come face to face with weird and unusual phenomena associated with air when sonic velocities are approached.

For many years compressibility has been a much-discussed subject among aerodynamicists, engineers and pilots. The optimistic aviation-minded public heard of the word, dismissed it, and kept on predicting that airplanes would fly faster and faster.

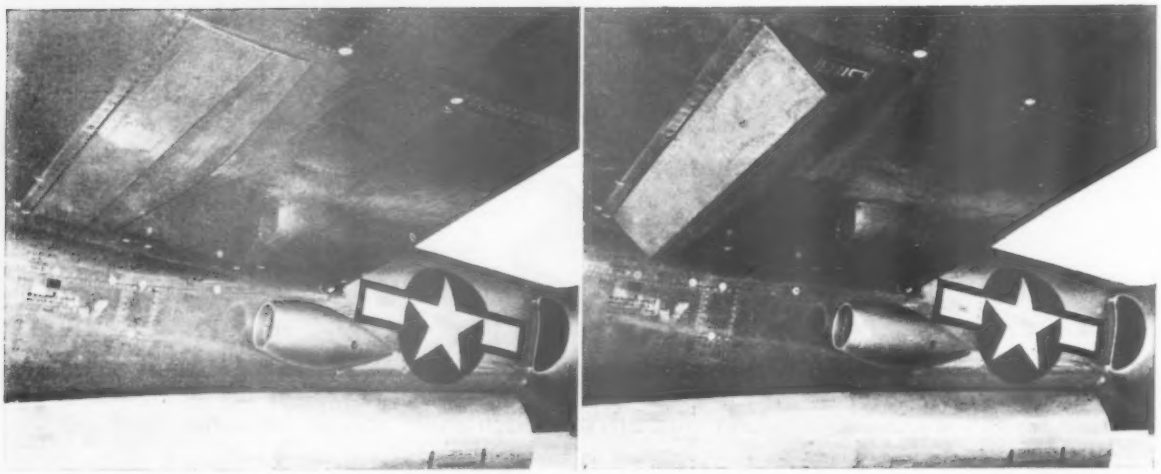
This later prediction was carried out during the early stages of aviation development. Between 1920 and 1930—the increase in level flight aircraft speeds averaged 19 m.p.h. per year. The 1920 and 1930 speed increases plotted on a graph and extended to 1940, indicated that an average speed of 575 m.p.h. should have been attained at that time. That it was not was no surprise to aviation engineers who knew that somewhere in and around 500 to 600 m.p.h the principles of aerodynamics as commonly applied would suddenly boomerang and that entirely new principles would have to be worked out.

The boomerang came with the advent of the new "hot" pursuit planes, designed to meet the pressing speed requirements of World War II. Engineers had been studying compressibility in wind tunnels prior to encountering it in flight. They soon realized that designating airplane speeds in "miles per hour" was misleading when sonic velocities were approached. Because sound travels at 764 m.p.h. at sea level and 664 m.p.h. at 35,000 feet altitude, and because compressibility occurs at or slightly below sonic speed, a new method of designating aircraft speeds in relation to sonic speeds had to be established.

The Mach number was adopted for this



Turbulence begins 30 per cent of chord length back from leading edge of conventional Airacobra wing, top, and 50 per cent back on laminar-flow wing of Kingcobra, bottom. Umbrellas indicate drag.



By creating counter-turbulence to that produced by compressibility, Lightning wing flap aids planes to pull out of high-speed dives.

purpose. The Mach number is obtained by dividing air speed by the speed of sound at any particular altitude. Thus a body traveling 764 m.p.h. at sea level would have a Mach number of 1.0 (written M 1.0); the same body moving at 664 m.p.h. at 35,000 feet altitude would retain the same M 1.0.

The critical Mach number of an airplane designates the speed at which compressibility occurs at any specific altitude, thus destroying the flight characteristics of that particular model. In design analysis, critical Mach numbers are established also for various aircraft components, such as the cowling, windshield, or other protuberances that enter and interfere with the normal flow of air past the fuselage.

The critical speed at which compressibility occurs with an airfoil is a function of airfoil design as well as air speed. In this conjunction, the Mach number is especially valuable in designating a safe terminal velocity for any specific airfoil design. If, for instance, compressibility with resultant shock stall occurs at M 0.8 at sea level, the same phenomenon will occur at M 0.8 at 35,000 feet altitude. Air speeds, however, will differ, being eight-tenths the speed of sound at either altitude, or 601.2 m.p.h. and 531.2 m.p.h. respectively. This is a reversal of the general opinion that airplanes can travel faster at higher altitudes due to the air being less dense; therefore offering less resistance to flight.

A lot of pilots were spared a quick and smashing death by a comprehensive study of compressibility effects by aerodynamic engineers using the wind tunnel and camera. Others were less fortunate and died in an attempt to explore this unknown region of weird aerodynamic phenomena.

Col. Signa A. Gilkey, former chief of the Flight Test Section at Wright Field, was the first pilot to go "over the edge." It was in the fall of 1940 and he was test-flying one of the first three *Lightnings* delivered to the Army Air Forces. With plenty of air beneath his wings, Colonel Gilkey nosed into a routine test dive. One minute the new pursuit job was flying as smoothly as a glider over a summer meadow. The next instant it was thresh-ing and lunging as if it were being held on a chain and blasted by the world's worst hurricane.

Colonel Gilkey was not sure what had happened and lost no time in getting out of the predicament. Aerodynamicists were more certain, however, and nodded sagely in agreement. Colonel Gilkey, they said, had entered that mathematically predictable but hithero unexplored zone of compressibility. For the first time an airplane had attained a speed nearing the velocity of sound and the pilot had lived to tell the story.

Ralph Virden, of Lockheed, was the second man to go "over the edge" into the zone of compressibility. He was killed. He nosed over into a dive from which he could not recover and the only data engineers gathered from his sacrifice was that compressibility was a real and serious problem that was going to demand a lot of work in its solution.

During wind tunnel studies, much use was made of the camera in determining the characteristics of compressibility and the nature of shock waves. When air is compressed, its refractive index is changed and it is possible to note this phenomenon on a photographic plate. Thus it is possible to "picture" the shock waves that occur on an airfoil when the air rushing past it exceeds safe terminal velocity. By studying such pictures, engineers have been able to alter airfoil design to raise the critical Mach number and thus afford safety from compressibility at ever greater speeds.

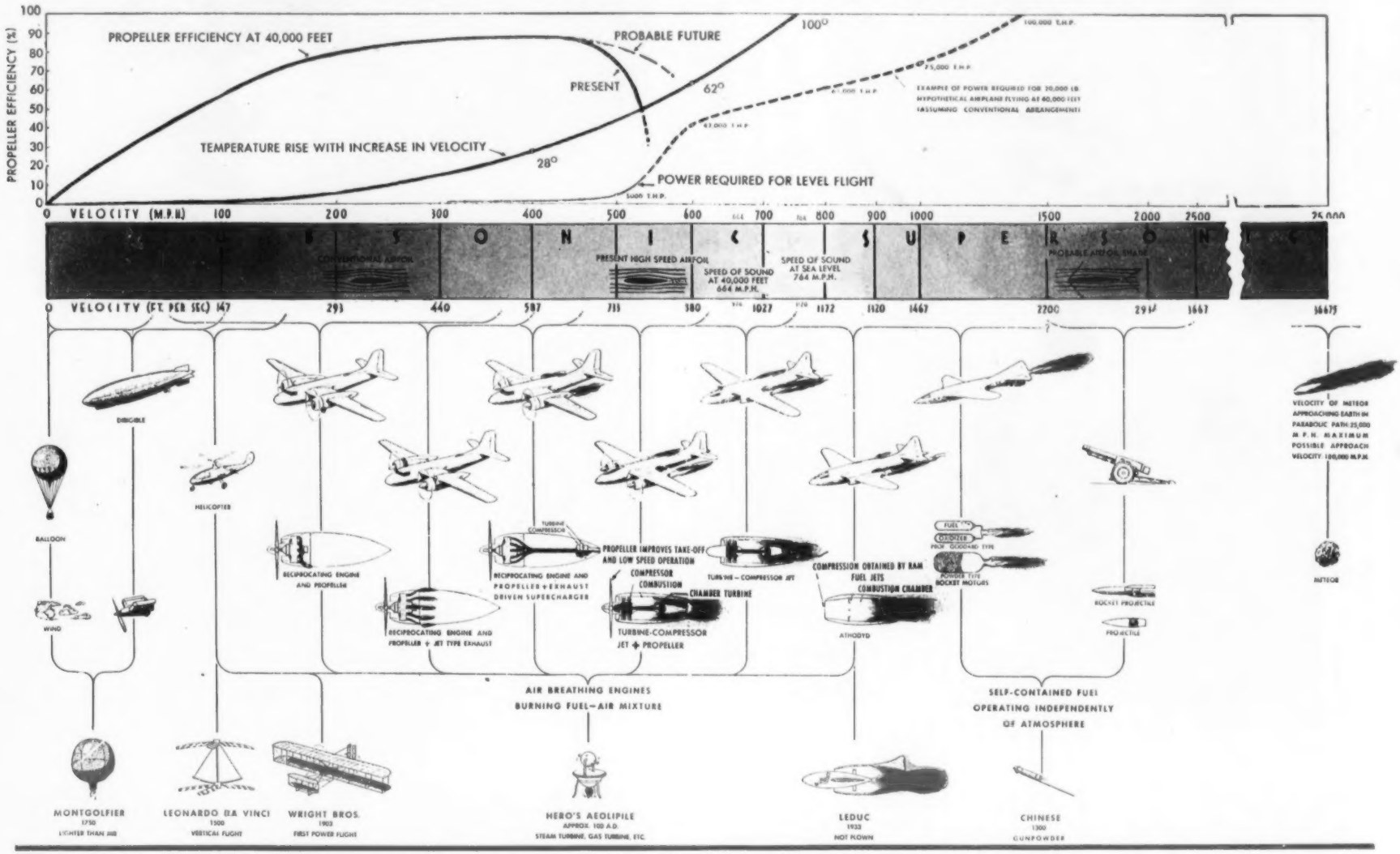
This is not to imply, however, that airfoils have been designed or will be designed that will have a critical Mach number of 1.0. Any conventional airfoil, however thin, produces vertical displacement that must be added to the forward speed of the plane to obtain the true velocity imparted to the air. Thus the ratio between the vertical movement of air and the lateral speed of the airplane will remain as the ratio between critical air speed and the speed at which compressibility theoretically should occur. Bridging this gap will require an airfoil that in some manner can secure dependable lift regardless of compressibility effects.

In studying compressibility a rough comparison may be drawn between air and water. A rowboat passing slowly across a lake creates little disturbance in its wake. The liquid medium conforms readily to the contours of the boat and maintains a normal level during its passing. But put a motor on the boat, increase its speed, and things begin to happen. The water flys out in a spray from the

(*Continued on page* 112)

Cross-section of Mustang wing tip emphasizes clean lines of laminar-flow design which has increased airfoil efficiency.

FLIGHT AND PROPULSION SPECTRUM

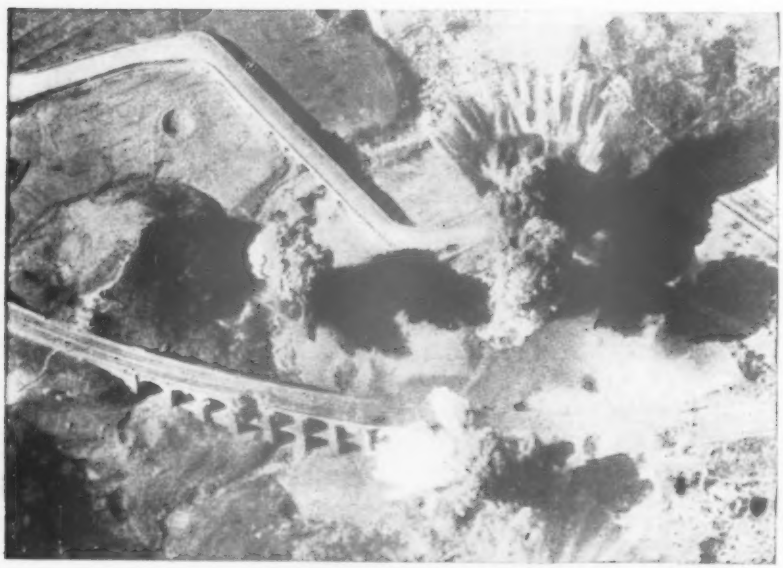


This is the spectrum of flight as conceived by Douglas Aircraft Company engineers. From top to bottom it consists of four divisions, arranged left to right according to increasing speed. At top, left, the first curve shows limitations of propeller-driven aircraft. The second curve indicates how the temperature of a body traveling in the earth's atmosphere increases with velocity—showing necessity of cooling or operating at higher altitudes. The third curve, also at the top, illustrates the problem of attaining speeds of 600 m.p.h. or greater with a conventional propeller-driven airplane.

The second division of the chart shows the probable evolution of high-speed airfoils. Below this the third division shows evolution of flight in the earth's atmosphere—from the slowest, the free balloon, to the fastest—the meteor. Between these two flight can be placed in four groups: (1) lighter than-air ships, (2) heavier-than-air craft powered by air-breathing engines and propellers, (3) air breathing jet engines, no propellers, (4) non-air-breathing rockets and projectiles. The fourth division, at the bottom, shows the simple origin of many aviation devices.

Part of the job of strangling German communications was the bombing of ports and waterways. Here is sunken ship at Leghorn.

Success of the drive on Rome required that enemy-held transportation systems in middle Italy be destroyed. Here is how the Allied air forces did it.



Tactical aircraft destroy Bucine railroad bridge and highway viaduct. Before the operational strangle, railroads could carry eight to 10 times German requirements.

YOU have read about the uses of airpower to destroy enemy communications. This remarkable picture sequence is a case history of such uses—the events leading up to the fall of Rome last June 4. The entire enemy-held transport system through middle Italy—rail, coastal shipping and road—was the target of Allied tactical air forces under Maj. Gen. John K. Cannon.

The Germans had been a well-supplied army. Between the first day of "operational strangle" on February 28, and the middle of March, every large and medium-sized rail yard in Italy was rendered useless. By March 24 no through line led to Rome. Without transshipping, the closest approach was 125 miles from Rome and only two small yards and a passenger terminal were useable in that city. Supplies fell to a trickle.

The air assault followed this plan:

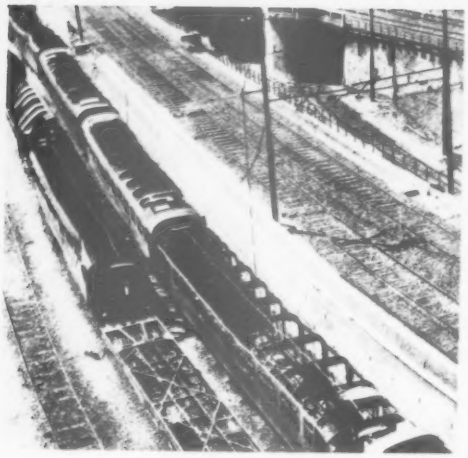
1. Knock out the marshalling yards in middle Italy.
2. Cut the bridges to force the Germans to lean on motor transport.
3. Smash the ports, to force them to use more motor transport.
4. Finally, go after the roads and the motor transport itself.

When the Germans tried to bring in supplies by sea the ports were smashed. *Mitchells, Mustangs, Marauders, Bostons, Airacobras, Warhawks,* and *Thunderbolts* were used. What they accomplished is shown on this and the next four pages.

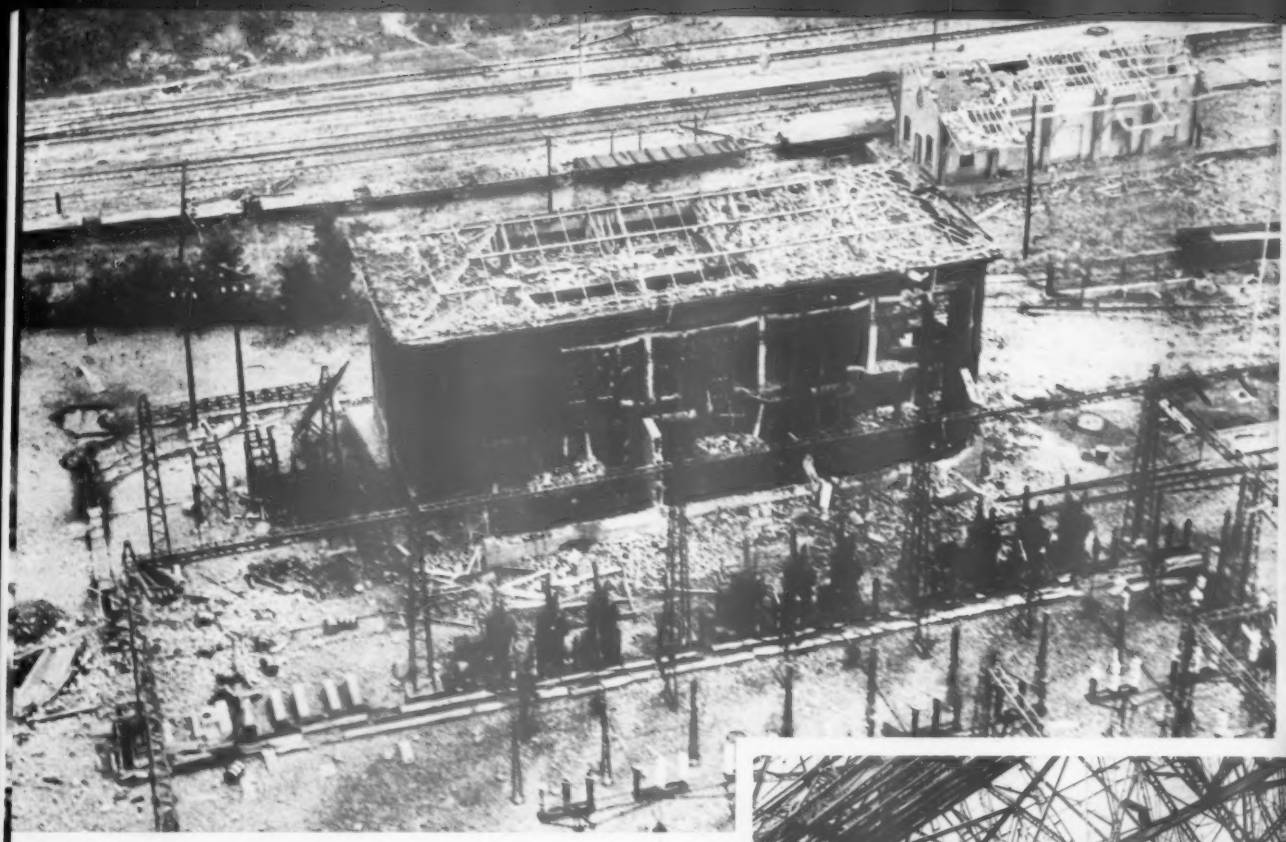
A vital requirement of "operational strangle" was to knock out the port facilities. This is part of wreckage of Leghorn harbor, where 50 attacks dropped more than 1,100 tons of bombs. Shipyards, wharves, storage areas, rail lines, industrial sections and a huge oil refinery were blasted.

The general strategy was to force rail and ship traffic onto the highways—then bomb and strafe the highways. In May, tactical planes destroyed 2,768 motor vehicles.

An important success of the tactical air force was the destruction of the Bucine viaduct in the Arezzo area while a train was passing over it. Between January 1 and July 15, bridges, highways, rail lines, rail yards and repair shops at Arezzo were blasted with 18,000 tons of bombs.

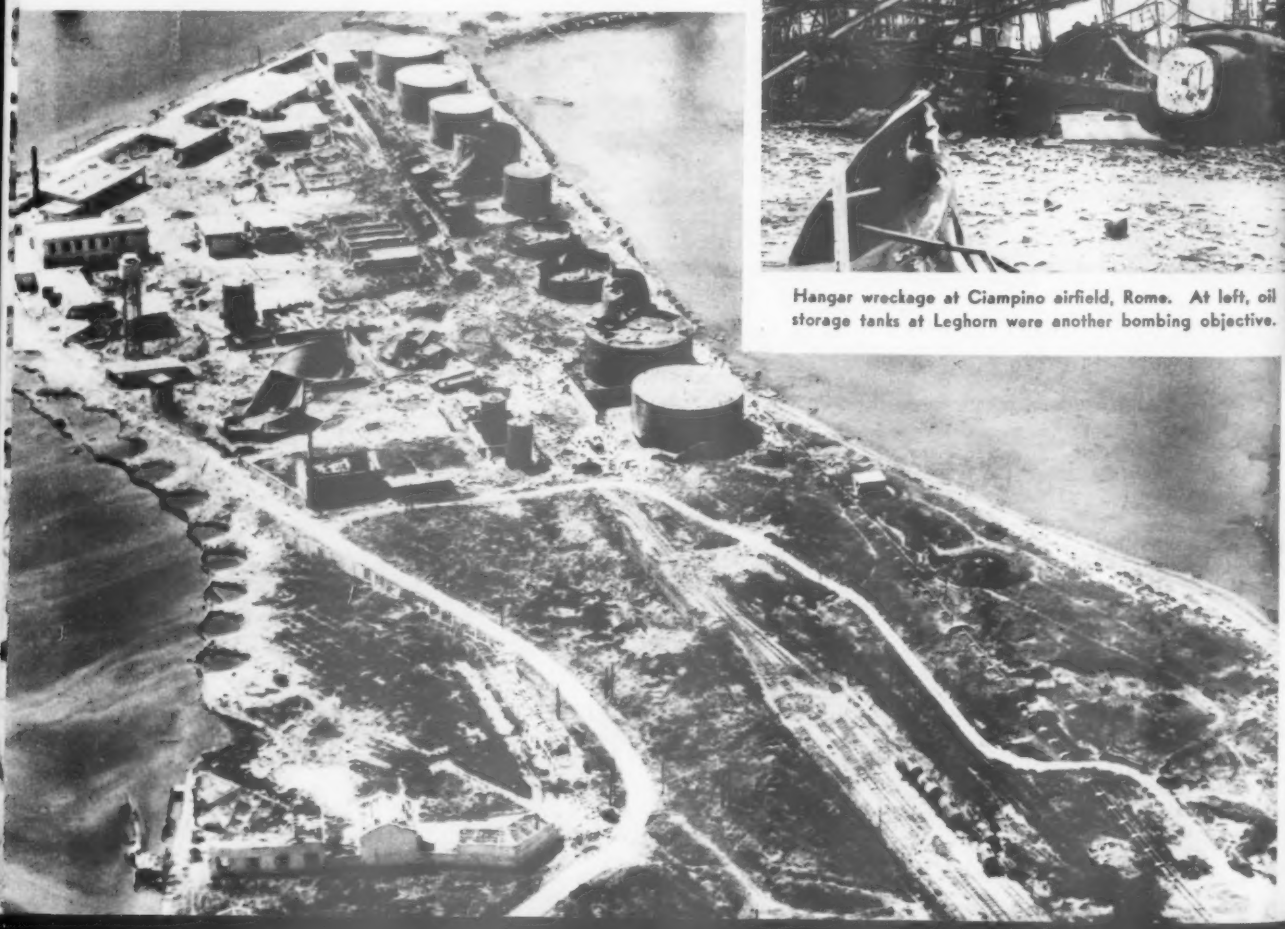


The bombing of rail marshalling yards was especially important in snarling traffic. Above photo shows destruction of train in Littorio yards in Rome. Below, damage at Ancona marshalling yards beside Ancona harbor. In one month of "strangle" 773 tracks were cut.



Many of Italy's railroads are electrified. When this power house was demolished at Arezzo, rails and other communications went out, industries depending on the electricity for power and illumination were forced to shut down. This rail center was especially important to the Axis because of its location on the main Rome-Florence route.

Hangar wreckage at Ciampino airfield, Rome. At left, oil storage tanks at Leghorn were another bombing objective.



Lightning TEST FLIGHT

This is a P-38J—the modification of the Lightning currently used in combat—being test-flown at Burbank, Calif. Wing span is 52 feet. Weight with a full load is nine tons, making it the world's heaviest fighter.

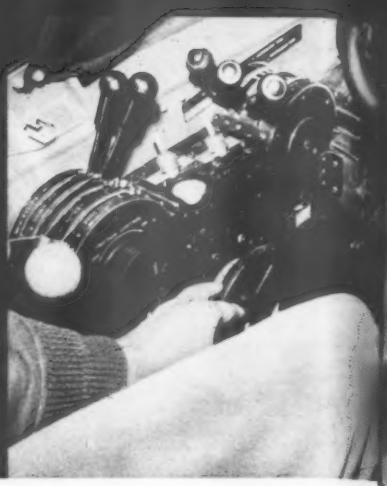
The acceptance test flight of an AAF fighter is a painstaking, careful process.

ONE of the highest AAF priorities for fighters is assigned to the Lockheed *Lightning*. The *Lightning* production program has been, and still is being, greatly expanded. The P-38J, the version currently in production, is being built in large numbers at Lockheed's Burbank, Calif., plant, and at the Consolidated Vultee plant in Nashville, Tenn. The photographs on this and the following three pages were taken for FLYING at Burbank. They show one of the many *Lightnings* produced at that plant in a single day being put through its acceptance test flight.

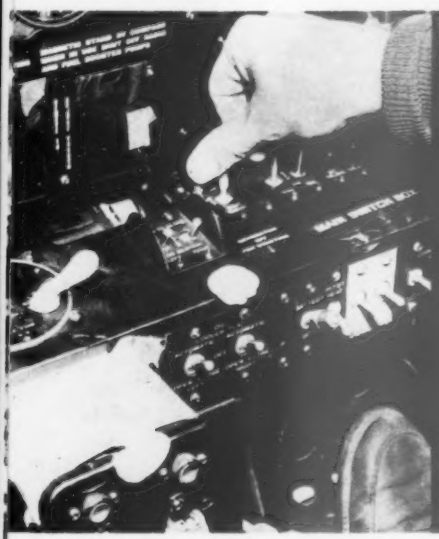
The P-38J is the 16th modification of the *Lightning*. It has the biggest engines yet: two Allison V-1710's, each developing over 1,600 h.p.

1 Equipped for flight, Lockheed's chief test pilot, Joseph Towle, checks radiator flaps.

2 After donning mask, pilot sets flow of oxygen, used from ground up in altitude tests.



3 Rudder pedals adjusted, pilot checks el... vator trim tab. Take-off setting is ze... Fue... alte...



7 Master ignition and both mags on, pilot presses energizer and starter switches.

8 For starting the engines, mixture control is opened to auto-rich, throttles ¼-inch.

9 After routine instrument check, hydra... pressure is checked by lowering the fl... Gyr... while...

13 On tower frequency, pilot presses control-wheel mike button for take-off clearance.

14 Props in low pitch, throttles are advanced to stops adjusted for full r.p.m. allowed.

15 Air borne, pilot has checked plane's ... off characteristics without use of f... Land... throt...

Fuel tank selectors are turned on. Use of alternate tanks maintains trim in flight.

5 Mechanic wheels out battery cart. He will make connections when engines are primed.

6 Engines are primed after props have been turned manually to free cylinder valves.

Gyro horizon is uncaged prior to take-off, while gyro compass (left) remains caged.

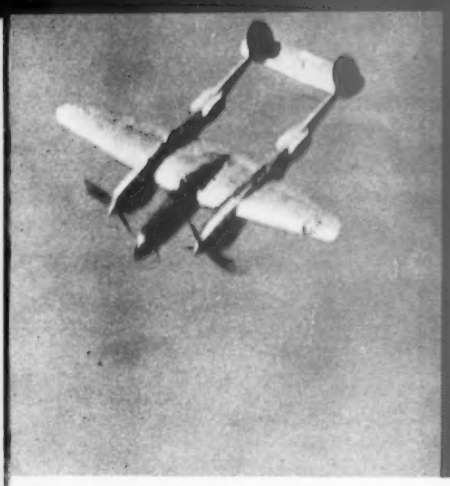
11 Engines warmed up, mechanic signals all-clear and pilot taxies to head of runway.

12 Auxiliary fuel pumps are switched on and a final run-up checks engines on both mags.

Landing gear lever, located on the side of throttle and trim tab pedestal, is raised.

17 Power is then reduced for normal climb and plane is leveled off at about 5,000 feet.

18 Elevator tabs are trimmed for level flight before pilot begins routine test maneuvers.

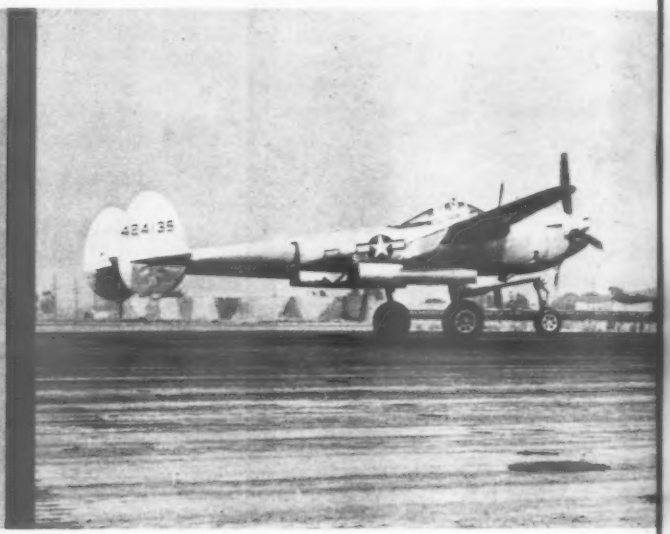


19 Test includes dives, rolls, inverted flight and determination of the maximum climb.

20 One engine stopped, prop full feathered, plane's ability to keep trim is checked.

21 Pilot notes any flaw in plane's perfor ance on test form strapped on his le

22 Flight test completed, pilot does a routine approach to field, lowers landing gear and flaps for landing.



23 Flaps full down and prop at low pitch, plane touches down on main wheels. Nose wheel settles automatically.

24 Guided by mechanic's signals, pilot taxies plane back to its position in flight line.

25 With fuel mixture full lean, engines are cut. Radio is turned off, the brakes set.

26 Pilot reviews plane's performance with crew chief—if it's okay, he signs it

LOCKHEED LIGHTNI

(P-38J)

Two liquid-cooled Allison V-1710 engines, over 1,600 h.p.

WING SPAN: 52 feet.
LENGTH: 37 ft. 10 in.
HEIGHT: 12 ft. 10 in.

TOP SPEED: over 425 m.
GROSS WEIGHT: 18,00(
SERVICE CEILING: over 4

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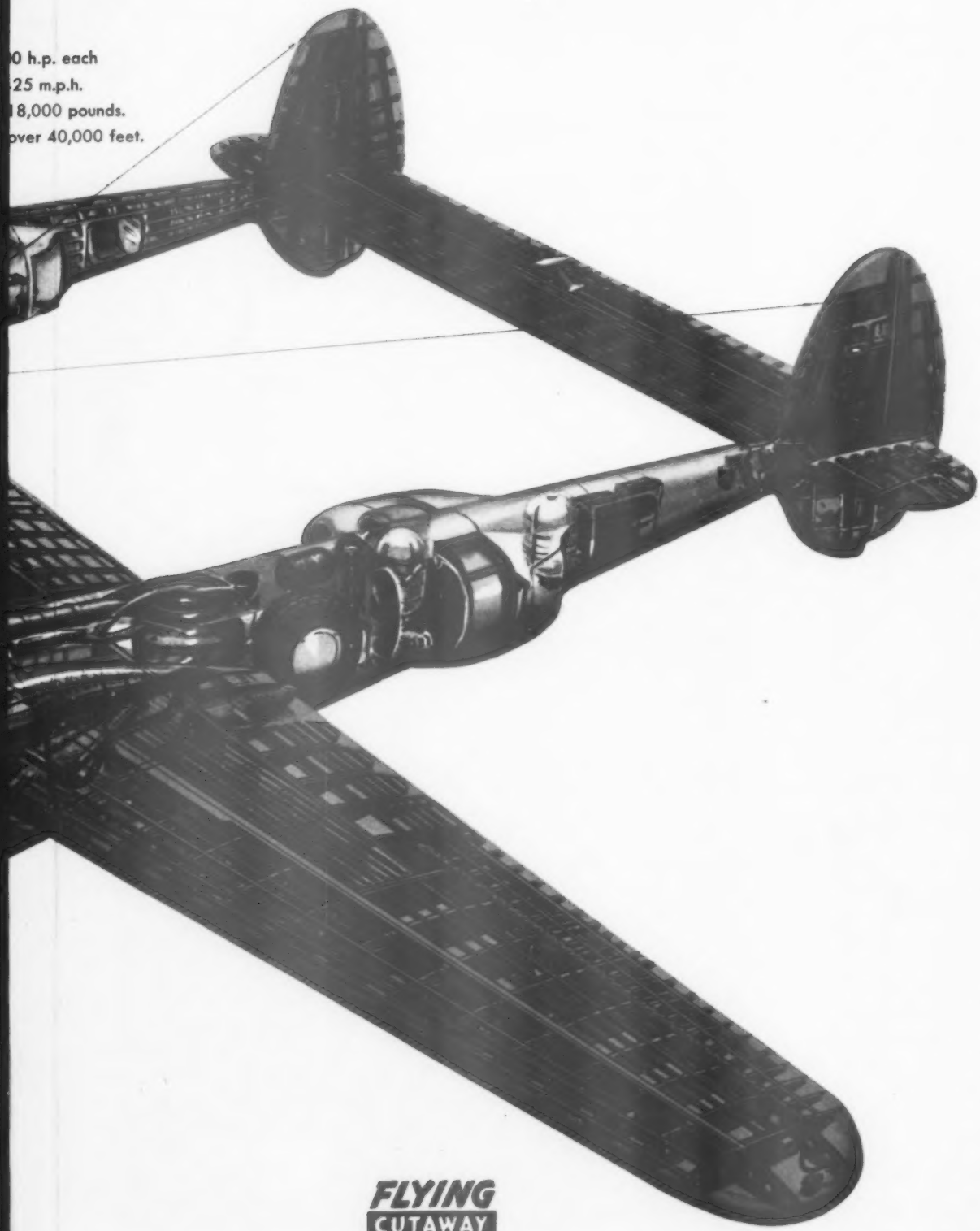
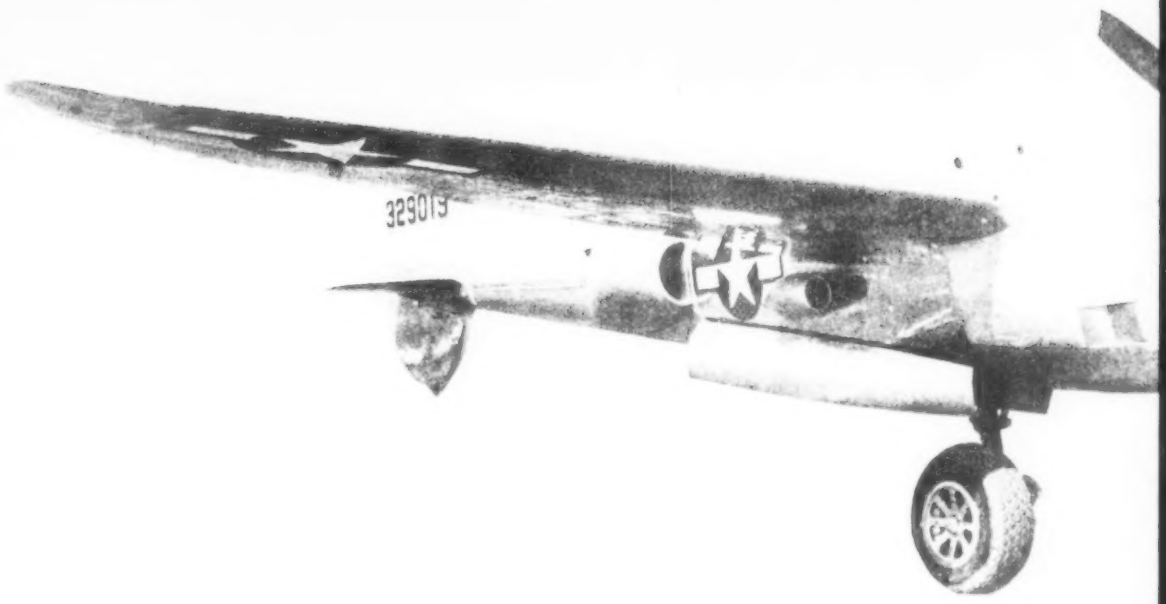
0 h.p. each
25 m.p.h.
8,000 pounds.
over 40,000 feet.

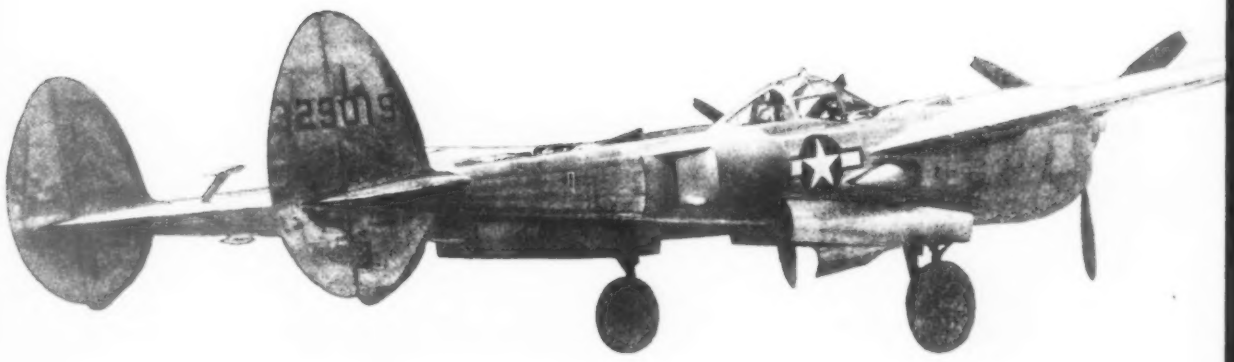


FLYING
CUTAWAY

by

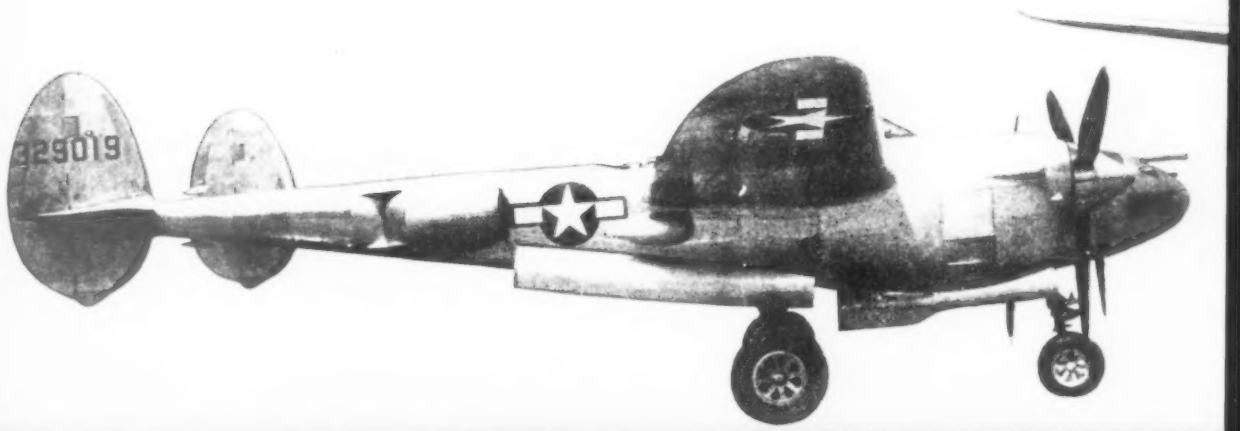
REYNOLD BROWN

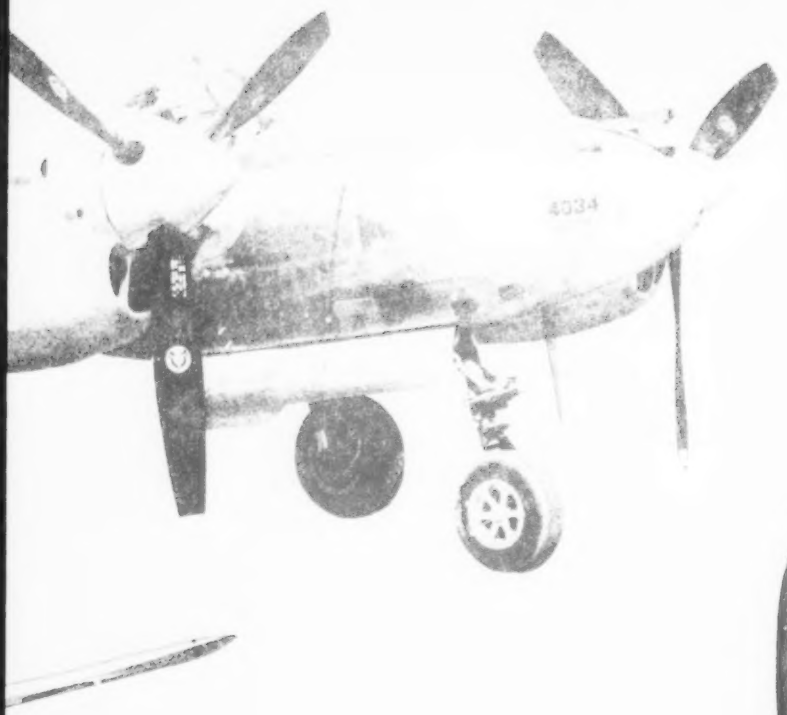


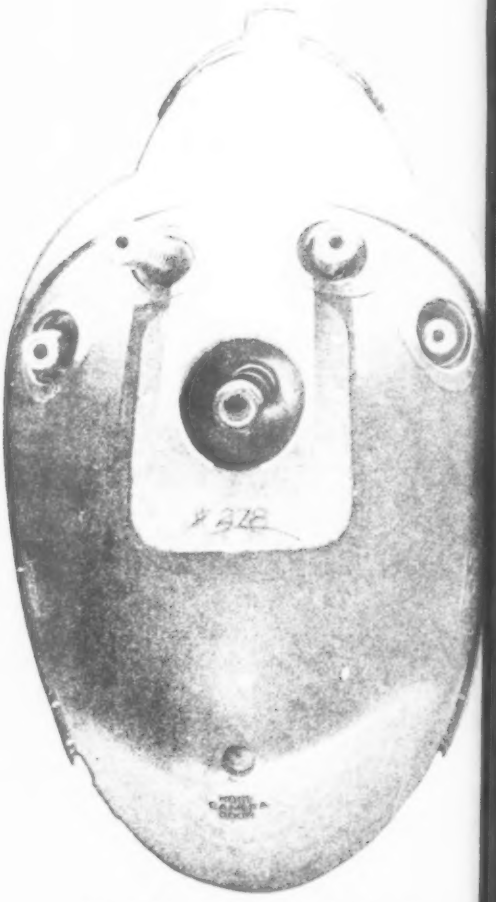


OTHER VIEWS OF THE LIGHTNING

FEW combat aircraft are as versatile as the model of the Lightning now in operation. Though its primary job is fighting, the P-38J is equally adept as bomber (4,000 pounds of bombs), camera plane and glider tug. Its two Allison engines develop over 1,600 h.p. each and its maximum range with droppable wing tanks is over 3,000 miles. The first Lightning was made famous in February, 1939, when it was flown coast-to-coast in 7 hrs. 4 min., averaging 340 m.p.h. Top speed today is over 425 m.p.h.







Lightning's armament is four .50-cal. machine guns in arc around 20-mm. cannon in center of nose. Six rocket launchers also are carried.

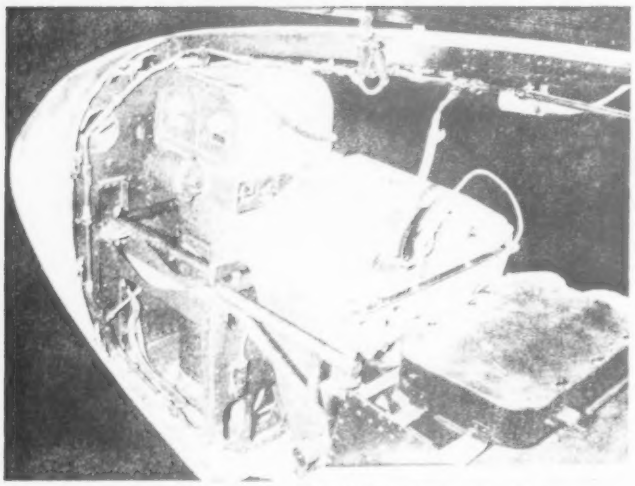
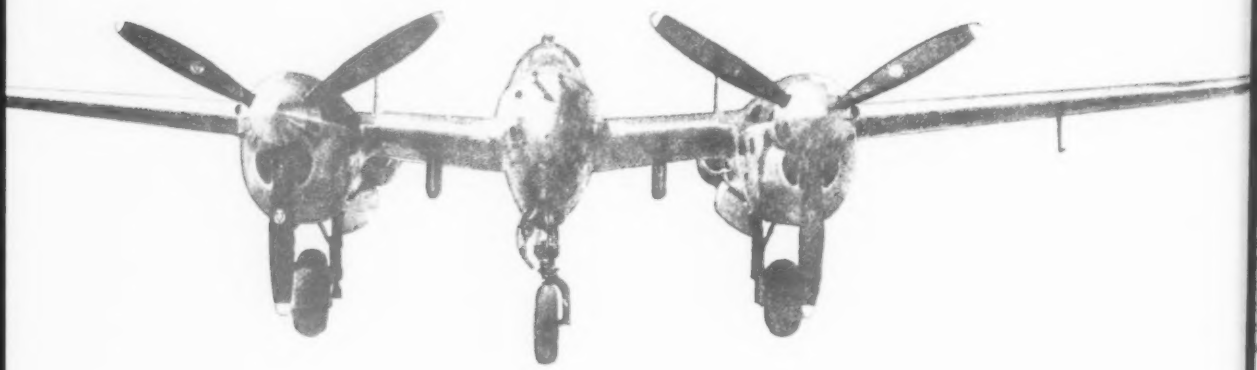


Photo-reconnaissance version of the Lightning is the F-5. All guns are removed and the nose filled with a number of cameras.



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LONDON Letter

By Maj. OLIVER STEWART

British Authority, Editor of Aeronautics

LONDON

FOR three years after the prototype had flown, Britain's War Office kept performance details of the tank-carrying *Hamilcar* glider, made by General Aircraft, on the secret list. When the facts about this 110-foot span, wooden airbarge were released, they augmented the already high performance record which Britain's airborne forces have made in this war.

Even so, it is recognized that the *Hamilcar*, which performed so well in Normandy on D-Day and in Holland on September 17, is but a first step. Eventually some of the heaviest military equipment will be transported by aircraft.

With a gross weight of 36,000 pounds, the *Hamilcar* can take a *Locust* or a *Tetrach* tank, a 17-pounder gun, or a bulldozer—all with their crews. Bigger than the Handley Page *Halifax* which usually tows it, the *Hamilcar* has a loading space 19 ft. 8½ in. long.

Here are same of the alternate loads which it can carry:

Tetrach tank with crew of five—15,680 pounds.

Mortar carrier with crew of five—9,280 pounds.

Seventeen-pounder gun with crew of two—7,000 pounds.

Bulldozer—15,920 pounds.

With wooden, stressed-skin, high wings and fabric-covered fuselage, the *Hamilcar* is a conventional job. Among the very few special devices are automatic opening for the nose door, which swings aside as a tank is driven out; the built-on, two-pilot, tandem cockpit, and the tab servo on the starboard aileron.

Choose Avengers

Improved naval aircraft and a bright future for Britain's Fleet Air Arm are expected now that a naval officer, Comdr. Rupert A. Brabner, has been appointed Under-Secretary of State for Air and Vice-President of the Air Council. He succeeds Capt. Harold Balfour.

Brabner is an accomplished pilot and did some of the early experiments in flying *Spitfires* from carrier decks. He won a DSO (Distinguished Service Order) in Malta convoy action, fighting his ship-borne *Hurricane* resourcefully and executing an emergency landing on another carrier—already overcrowded—when his own was sunk.

The Royal Navy has complained in the past that, whereas the RAF has the pick of many aircraft companies, it must choose from only two or three different tenders to any specification. It is now unlikely that the Fairey *Barracuda* will be seen in numbers in the Pacific. For the time the Grumman *Avenger* is the Royal Navy's choice for this theater. Rumors of new British Fleet fighters and torpedo carriers are going round but, up to the time of this writing, there have been no official releases.

Unified Service?

Increased understanding of the way in which air power is mingling with land and sea power has revived the demand for amalgamation of the three fighting services, the Navy, the Army and the RAF, into a single service to be called—according to one suggestion—the King's Service.

Marshal of the Royal Air Force Lord Trenchard has openly opposed any such scheme in the House of Lords. Trenchard, who still retains his 1914-18 nickname of "Boom," is an uncompromising advocate of independent air power who seems to disregard the many developments in unified airborne and air-sea operations.

Two earlier and equally uncompromising advocates of air power, Gen. William Mitchell and Gen. Giulio Douhet, saw a single fighting service as an arrangement which would allow air power fuller scope than any other.

Jet Controversy

Statements by correspondents that the Germans managed to do their reconnaissance for the Rundstedt push with the aid of the jet-driven Messerschmitt Me-262—plus the increasing frequency with which this aircraft appears in the official communiques—have led to a sterile controversy as to who really originated practical, jet-propelled aircraft.

Officially—through Britain's Ministry of Aircraft Production statements—Air Commodore Whittle is given chief credit. It would be more accurate, however, to describe Whittle as the originator of the practical gas turbine. Work was begun on one of his engines in 1936 and a Gloster aircraft fitted with such an engine first flew in May, 1941. Makers of the unit were the British Thomson-Houston Company of Rugby.

The Italian Caproni-Campini had flown before the Gloster. But its unit was not a turbine. It employed an ordinary reciproating engine to drive the blower. Dates of the first German jet flights (with the Junkers unit) are not yet known with

(*Continued on page* 142)

The tank-carrying British Hamilcar glider, which performed notably in the invasion of France, can carry tanks or bulldozers weighing eight tons. Its loading space is nearly 20 feet long.

SO YOU WANT TO START A

IT WAS easy in 1929. You made a down-payment on two or three cabin airplanes, started "scheduled" flights between Kalamazoo and Slippery Rock, and you had yourself an airline. Usually you had it for only a few months or maybe a year at most, a fact often overlooked in discussing the "good old days" of American aviation. Today, with the fledgling airline business of 1929 grown into a great transportation system, you can't start an airline so easily or so quickly, even if you have the money.

It's the Civil Aeronautics Act of 1938 that makes the difference. When this act became law, Federal protection and regulation of air transportation became a reality. The wildcat development days were over; airline operators had a chance to catch up on their sleep without fear of waking to find their economic throats cut by a fast merger or by a piratical duplication of service.

The Civil Aeronautics Act created the Civil Aeronautics Board, headed by five members appointed by the President. A separate and independent agency of the Federal Government, the Board was endowed with legislative, judicial and regulatory powers over American civil aviation. Therefore, before examining the present how's and why's of obtaining permission to operate an airline, it is important to understand certain functions and duties of the Board applying to the field of air transportation.

The Board's broad controls over economic regulation of air transportation have thus far been primarily utilized in (1) issuing certificates authorizing air transportation over new routes and (2) fixing the compensation to be paid air carriers for carrying mail. The Board's decisions authorizing international or overseas air services [defined by the Board as air service between the continental United States and a U. S. territorial possession or air service between U. S. territorial possessions], in contrast with domestic route cases, require Presidential approval because they involve re-

Small twin-engined AAF planes like the Beech AT-7 may be used on feeder lines.

T AN AIRLINE ?

Most of the 800-odd applicants for new airlines probably won't get certificates. Here are the procedures. Measure your qualifications against CAB's requirements.

By EDWARD E. SLATTERY, Jr.

Sportsman pilot, aerial photographer, aviation writer, the author is chief of public information for the Civil Aeronautics Board, now on temporary leave of absence. He wrote the article, "Make Flying Easier," published in the November issue of this magazine.

lations with various foreign countries.

Additional economic functions of the Board of interest to potential airline operators include the power to regulate tariffs and tariff practices, to regulate rates for the carriage of persons and property, and to require and prescribe the form of accounts, records and reports maintained by air carriers. The Board also has the power to approve or disapprove interlocking relationships, consolidations, mergers, and certain agreements entered into by American air carriers.

The certificate issued by the Board when it authorizes operation of domestic commercial air service is called a "certificate of public convenience and necessity." The first step in a series of actions seeking to obtain such authorization is taken when the individual or company files an application with the Civil Aeronautics Board.

The application may be a simple document; the answers to only six questions are required by the Board's regulations. Briefly, they are:

1. The full name and address of the applicant, the nature of his organization (individual, partnership, corporation, etc.) and the name of the state under whose laws it is organized.
2. A statement that the applicant is a citizen of the United States. Support of such statement may be presented at the hearing later.
3. Identification of each route desired, naming every terminal and intermediate point to be included in the certificate, and the type of service (mail, passenger and property) and whether services are to be rendered in scheduled operations.
4. A map in approximate scale showing all terminal and intermediate points to be served, giving approximate mileage between points and principal overall distances.
5. A statement as to type of aircraft applicant proposes to use and whether such aircraft is now owned.
6. If applicant does not hold a certificate authorizing air transportation, list the name and type of business of any affiliate, subsidiary, or principal stockholder of applicant engaged in any form of transportation as a common carrier, or engaged in any phase of aeronautical activity.

The form of the application may be as simple as two or three typewritten pages, or it may be a printed booklet if desired. The map may be drawn by hand or specially prepared. Twenty copies of the application must be filed with the docket section of the Board in Washington. A docket number is then assigned and used in all future reference to that particular application.

The next step is the assignment of a pre-hearing conference. The office of trial examiners of the Board appoints one, or sometimes two, of its examiners to preside over this informal meeting and later at the formal hearing. A public counsel is also appointed by the Board to represent the public interest. There will almost always be present several other applicants or their representatives, who desire to serve or are already serving the same general area.

In the past, applications were usually assigned for pre-hearing conference in the chronological order of filing. However, the tremendous influx of new applications, many of which desire to serve the same general economic-geographic area, made it necessary for the Board to alter this policy. Therefore the Board evolved its present policy of consolidating for hearing those applications seeking to serve the same general area. With more than 800 applications on file today, the Board gives notice to *all* applicants and operating air carriers when a pre-hearing conference is assigned. One of the major issues discussed at the conference concerns *what* applications should be consolidated for the hearing.

The pre-hearing conference makes it possible for all parties concerned to agree on procedural matters and allows them to file detailed summaries of the evidence to be presented and the proposed witnesses to be called. A future date is set for the exchange of exhibits, later to be presented at the hearing, and a tentative assignment date is named for the hearing. The procedure of exchanging exhibits prior to the hearing provides all parties with the full opportunity to prepare for cross-examination which will be a part of the hearing.

The exhibits usually contain the complete argument of the applicant in addition to statistical and other supporting data. Because of the many problems surrounding new route cases, oral statements may become lengthy and the hearing prolonged for several days. Therefore, to expedite hearings, which in turn saves the applicant time and money, and to have a clear and complete record on hand for study, the Board welcomes the introduction of evidence in the form of exhibits.

The formal hearing is open to the public and is generally held in Washington. The Board approves having its examiners hold hearings in the field when conditions warrant; recently 15 local applicants for feeder air service in the New England area and 13 intervenors had their cases heard in Boston by a Board examiner sent up from Washington.

Each applicant in turn introduces his own exhibit as evidence, and being familiar with all other exhibits due to the exchange action previously mentioned, prepares to cross-examine or be cross-

(*Continued on page* 145)

Flight Pay in the Services

Been wondering how much that airman earns? Here is the schedule, giving base pay and varied allotments.

ALL those serving in the armed services receive base pay. Additional pay is determined by the status of the individual and may include longevity, subsistence and (in some cases) rental allowances. Officers and men whose duties qualify them also receive flying pay, foreign service pay, parachute pay and pay as an aide to a general officer.

Retirement pay, except when an officer is recalled to active duty, is computed on the basis of his base plus longevity pay. There are no allowances.

Fogies (Longevity Pay): After three years of service there is a five per cent increase which is known as a "hitch," or longevity pay. The popular name is "fogy." This takes place every three years thereafter and both officers and enlisted men are eligible.

Flying Pay: Officers, warrant officers, nurses and enlisted men whose orders include regular participation in aerial flight are eligible for a 50 per cent increase, known as flying pay. All members of combat crews such as pilots, bombardiers, navigators, photographers, radio operators and gunners receive flying pay.

Non-flying officers, technical observers, etc., when required to fly frequently, receive an additional $60 a month for that period during which they are subject to flight assignment.

Foreign Service Pay: Officers and men who are serving outside the continental limits of the United States or aboard Naval vessels are entitled to foreign service (or overseas) pay. To the base pay of officers 10 per cent is added, and to the base pay of enlisted men 20 per cent is added.

Allotments (Officers): Before leaving for overseas or for sea duty in the Navy, officers may make allotments from their

(*Continued on page* 156)

GRADE					RENTAL		SUBSISTENCE	
Navy and Coast Guard	Army and Marine Corps	BASE PAY	BASE PLUS FLYING PAY	BASE PLUS FLYING & FOREIGN SERVICE	With Dependents	Without Dependents	With Dependents	Without Dependents
Admiral of the Fleet[1]	General of the Army[1]	$666.67	$1,000.01	$1,066.68	$120	$105	$42	$21
Admiral[1]	General[1]	666.67	1,000.01	1,066.68	120	105	42	21
Vice-Admiral[1]	Lieutenant General[1]	666.67	1,000.01	1,066.68	120	105	42	21
Rear Admiral[1]	Major General[1]	666.67	1,000.01	1,066.68	120	105	42	21
Commodore	Brigadier General	500.00	750.00	800.00	120	105	42	21
Captain	Colonel	333.33	500.00	533.33	120	105	42	21
Commander	Lieutenant Colonel	291.67	437.50	466.67	120	105	63	21
Lieutenant Commander	Major	250.00	375.00	400.00	105	90	63	21
Lieutenant (sg.)	Captain	200.00	300.00	320.00	90	75	42	21
Lieutenant (jg.)	First Lieutenant	166.67	250.01	266.68	75	60	42	21
Ensign	Second Lieutenant	150.00	225.00	240.00	60	45	42	21
Midshipman	Officer's Candidate[2]	65.00[2]	——	——	—	—	—	—
Aviation Cadet	Aviation Cadet	75.00	——	——	—	—	—	—
Chief Warrant Officer	Chief Warrant Officer (designated S/W)[3]	200.00	300.00	320.00	90	75	42	21
——	Chief Warrant Officer	175.00	262.50	280.00	60	75	42	21
Warrant Officer	Warrant Officer (jg), Flight Officer	150.00	225.00	240.00	60	45	42	21
Mates and Chief Petty Officers	Master and First Sergeants[5]	138.00	207.00	233.60	The amounts allotted in these brackets are determined by wartime congressional acts described in the accompanying text.			
Acting Chief Petty Officer	——	126.00	189.00	214.20				
Petty Officer 1/c[4]	Technical Sergeants[5]	114.00	171.00	193.80				
Petty Officer 2/c[4]	Staff Sergeants (Tech. 3rd)[5]	96.00	144.00	163.20				
Petty Officer 3/c[4]	Sergeants (Tech. 4th)[5]	78.00	117.00	129.60				
Seaman 1/c	Corporals (Tech. 5th)[5]	66.00	99.00	112.20				
Seaman 2/c	Private (first class)	54.00	81.00	91.80				
Apprentice Seaman	Private	50.00	75.00	85.00				

Note: sg means "Senior Grade"; jg "Junior Grade"; 1/c "First Class"; 2/c "Second Class"; 3/c "Third Class."

1. The base pay, rental and subsistence allowances of five-star, four-star, three-star and two-star generals and admirals is the same. However, the five-star general or admiral has a $5,000-per-year personal money allowance, the four-star general or admiral has a $2,200-per-year personal money allowance, and the three-star general or admiral a $500 personal money allowance in addition to service pay. Two-star and one-star generals and admirals get no additional allowances.

2. The Army equivalent in aviation for midshipman is "officer's candidate." The base pay depends upon the enlisted rank but cannot be lower than that of corporal.

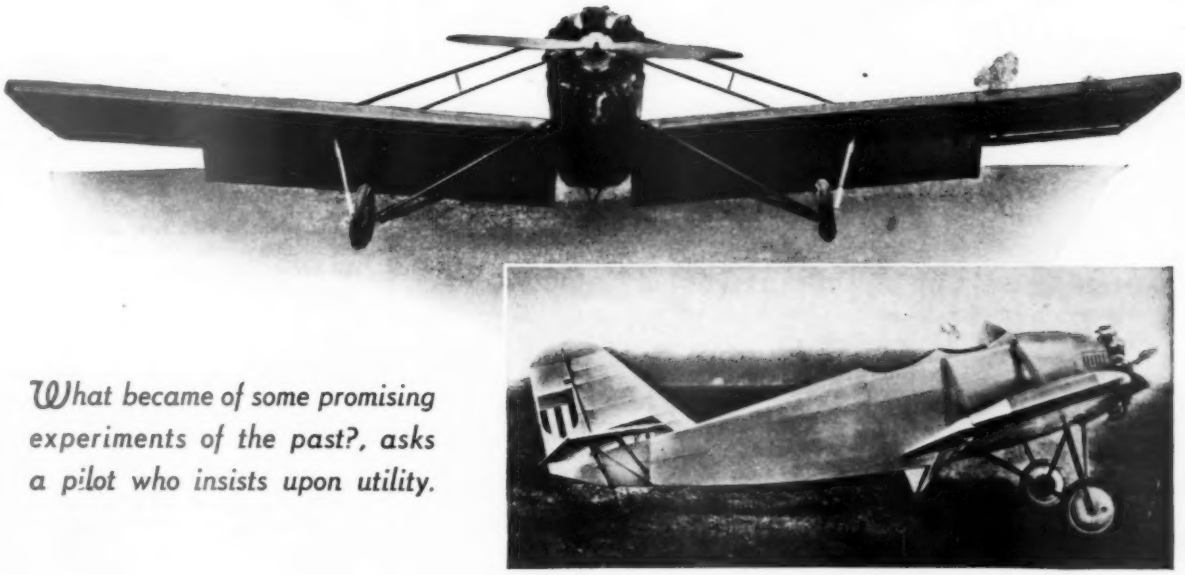
3. One group of Army chief warrant officers is designated by the Secretary of War. The rank is the same as chief warrant officers but the designated chief warrant officers receive more pay.

4. The pay grades given here represent a fair approximation, however the Navy uses scores of classifications, such as storekeepers, firemen, etc., and a complete breakdown would require considerably more space than can be given to the subject here.

5. There are no "technician" grades in the Marine Corps, and Marine and Army enlisted grades are different in the sergeant class. The Marine equivalent of staff sergeant is staff or platoon sergeant; for technical sergeant, the Marine equivalent is technical, gunnery or supply sergeant, and for master or first sergeant the Marine equivalent is first sergeant, sergeant major, or master gunnery, master technical, quartermaster or paymaster sergeant.

Make My Plane USEFUL

By CHARLES EVANS



What became of some promising experiments of the past?, asks a pilot who insists upon utility.

McDonnell Doodlebug of 17 years ago had inherent stability; its big flaps helped it to land in a 100-foot circle, gave it 30 m. p. h. landing speed.

THE "beautiful dream"—if that's what it is—of a roadable airplane for private use poses one question of tremendous importance to the aviation industry.

Will the industry build a plane for millions of Americans, or a plane for a few tens of thousands?

Certainly, American industry leans toward and yearns for, volume production. But the dreamer who dares to say what kind of an airplane he wants for his personal use, and the man ready to invest capital, too, I suspect, always bumps into the aeronautical engineer who says it cannot be done.

Well, why can't it be done? In 40 years of flying, every year one of progress, haven't we learned how to produce a useful airplane? Is there a group of responsible engineers who will say positively that it is impossible to build a practical family airplane?

For the family plane, three characteristics are all-important. It must have good take-off and landing characteristics if it is to be flown safely by just everybody, especially the novice pilots. Surely we know more about building high take-off and landing performance into a plane than we ever knew before. We have had sensational performance in this field since 1927—in isolated cases.

It must have load-carrying ability above and beyond what we have enjoyed in our private planes to date. Maybe the military flyers are proving a thing or two in this respect. They customarily take off with as much as twice the load permitted by the manufacturer's specifications, safely perform their missions and return home. In an emergency, a DC-3 has taken off with 66 passengers counted and six stowaways; yet airplane pilots in this country shudder when five of their 21 passengers happen to be chubby. Without question, we know more about load factors and safety factors from all this practical experience.

The third, and perhaps the most important item of the three, is production costs. We ought to be able to build a plane for less money than ever before because of the machinery and know-how we have amassed in war production.

Not included in these three characteristics is the matter of roadability because it is more important than all of them as the answer to a mass market.

As possible answers to these three problems, consider two planes of the past and our present wartime aviation picture.

What about the McDonnell *Doodlebug*? This low-wing monoplane was built in 1926-27 using a number of features which were patented at the time, and it had a performance that was little short of amazing. It took off and landed in a circle of 100 feet. It hovered over one spot facing into a 15- or 20-m.p.h. wind with its propeller just ticking over. Then it nosed down and landed into the same wind, traveling not 100 yards forward in completing its descent, and rolled to a stop.

This plane was purchased by the National Advisory Committee for Aeronautics, taken to Langley Field and, since that time, has never been mentioned in print. NACA's report is that the "project was surveyed and dropped." Whatever that means is not too important. The point is, what did the NACA or the industry learn from that plane and its competitors in the Guggenheim Safe Airplane Competition which may be applicable today? Why did not NACA follow up on it? Why has the industry ignored this promising performance?

This is what a plane had to do to make a perfect score in that contest: Land at 30 m.p.h., have a high speed of 130 m.p.h., run not more than 40 feet on landing, not more than 75 feet on take-off and have sufficient stability to recover from any position "hands off" and fly "hands off." Thus the designers worked for high lift, maneuverability at the stall position and great strength with light construction, particularly in the landing gear.

J. S. McDonnell, Jr., demonstrating his plane, repeatedly landed and took off in a 100-foot circle staked with small flags on the airports. He actually "hovered" for 15 minutes above one spot at Ford Airport one day in a 15- to 20-mile wind, his propeller turning just enough to keep the wind from blowing him backward. He designed the plane so that the amateur pilot could pancake it from 50 feet or glide into the ground without leveling off. His landing gear would withstand a vertical descent of 18 feet per second. A parachute descends at 22.

And that airplane did not win the competition! Yet, when a dreamer with his

UNCONVENTIONAL—BUT USEFUL

Roadability was the prime feature of Waterman Arrowbile, powered with a converted 100-h.p. Studebaker engine. Author says this plane cruised at 100-105 m.p.h., landed at 40-50 m.p.h., traveled 70 m.p.h. on ground.

mouth watering to fly speaks out for a plane that will land at 30 m.p.h., a modest cruising speed of an honest 100 m.p.h., and ability to get in and out of small fields safely and carry a decent load, the engineers jump down his throat.

Second, consider the flying wing type airplane of small size suitable for the private owner.

Skeptical and inaccurate pilots described our first tailless airplane as a one-speed airplane, saying that it took off, cruised and landed at 80 m.p.h. However, the five Waterman *Arrowbiles* built for the Studebaker Company in 1937 powered with converted Studebaker 100-h.p. engines, showed top speed of about 115 m.p.h., cruising at 100-105 and landing at 40-50 m.p.h. Weight empty was 1,940 pounds and loaded, 2,500 pounds. It was a two-place plane and had many interesting features, one of which was a V-belt drive for the propeller. It had a speed of 70 m.p.h. on the ground.

Here was a promising airplane. Was it a fear of the unconventional that prevented its further development and if so, can the aviation industry afford to fear the unconventional?

The third question, which may have to remain in the academic stage at this time, is this: What have we learned on this problem of the design of the private flyer's plane from our intensified wartime development?

So far, only one company has advertised a roadable plane. General Aircraft of Long Island adds a line to its announcement of two new models, "—and one of them's roadable too." That, with the exception of Cessna's advertising, is virtually all the public information available to those who want a family plane. Cessna very carefully goes just so far, saying, "You will be able to learn to fly the plane the first time you get into the air. After a few hours you will be confident of your ability as a pilot. It is a plane you will be able to buy and fly and use."

Stinson and Ryan have produced high performance planes that promise something for the private owner, but they are war planes. Stinson's *Sentinel* looks like a lightplane but it has a 185-h.p. engine—too big for the average family man to support financially. Besides, it carries only two passengers. Ryan's *Dragonfly* took off on nothing, almost hovers, and can land almost anywhere. Perhaps the two companies have commercial designs under study or ready but so far the millions of prospective purchasers have nothing but feature writers' guesses to lead them toward the dotted line.

Granted that the elements of wise competition justify any manufacturer in withholding special features of his post-war plane and that, after all, these companies are entitled to keep their "civilian secrets," it would still seem there is information which could be given. It would make a difference in many a man's personal post-war planning if he knew that he could buy a vehicle which would provide many of the services of the automobile and those of the airplane too. Some 3,000,000 men are in our Air Forces today. They are indoctrinated with the flying virus. Three hundred thousand of them are pilots. In addition some 2,500,000 men and women are working in aircraft factories. Perhaps a million young boys and girls are now crowding the flying schools to take flying instruction. They are all thinking and talking airplanes. Several million Americans have become stay-at-homes because of war's restrictions, and they are eager to get out on, or over, the road again. Here is a quantity market.

If they buy an airplane it must be much more than just an airplane, because the record of airplane ownership in the United States is bad. After 3.44 years on the average, the airplane owner gave up, sold his plane and stayed on the ground.

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SUPER FUEL FOR AIRCRAFT

By George H. Freyermuth
Technologist, Standard Oil Company (N. J.)

Today our superb gasoline gives us the advantage in war. Tomorrow it will improve our civil planes.

WITHOUT 100 octane aviation gasoline our aerial successes and our margin of superiority over the best pilots and the finest planes of the Axis would be far less than they are today.

Here we have had the inside track on our foes. This super fuel permits our engine designers to develop more powerful and more economical engines. These, in turn, let our bombers take off with heavier loads or fly farther, or climb faster, or take off in greatly restricted spaces. More power per pound of engine adds to the speed and power of fighters or makes it possible to give extra protection in the form of added armor and greater firepower. Many of our planes come back from fights aloft battle-scarred but intact because of this protection.

The story of 100 octane is one of a fuel that a few years ago could be produced only in relative cupfuls and cost $25 per gallon. Even when commercial processes to make it were available the oil companies that had spent millions of dollars on its development could not sell their full production because the engines to use it were not yet developed. But today these engines are ready by the millions of horsepower.

The advantages of 100 octane are by no means theoretical. With 100 octane gasoline instead of 87 octane—until recent years the best aviation gasoline available—a given design of airplane, in round figures, can develop 20 per cent more power for take-off and will use about 15 per cent less gasoline for a given flight. Apply this to a four-engined bomber with each of its engines developing 1,500 h.p. and you'll find that when bombing a target 1,000 miles from its base this plane can carry about five additional 1,000-pound bombs. And 5,000 additional pounds of bombs per plane in a 1,000-bomber raid means 5,000,000 extra pounds of concentrated grief dumped on Berlin or Tokyo, or wherever you want to dump it. This 100 octane powered plane can fly hundreds of miles further to drop a given number of bombs on its target than it could fly using 87 octane gasoline.

The word octane doesn't mean much to the layman. Look it up in a standard dictionary and you'll see it defined as "any of a group of eight-carbon-atom isomeric hydrocarbons of the paraffin series," which is just so much gibberish to the average layman. Octane number is something else again. It is a performance rating of a fuel which indicates its ability to resist "detonation" or "knock" in a high compression engine. The higher the compression of an engine the more power delivery for its size. If this higher compression is gained by higher compression

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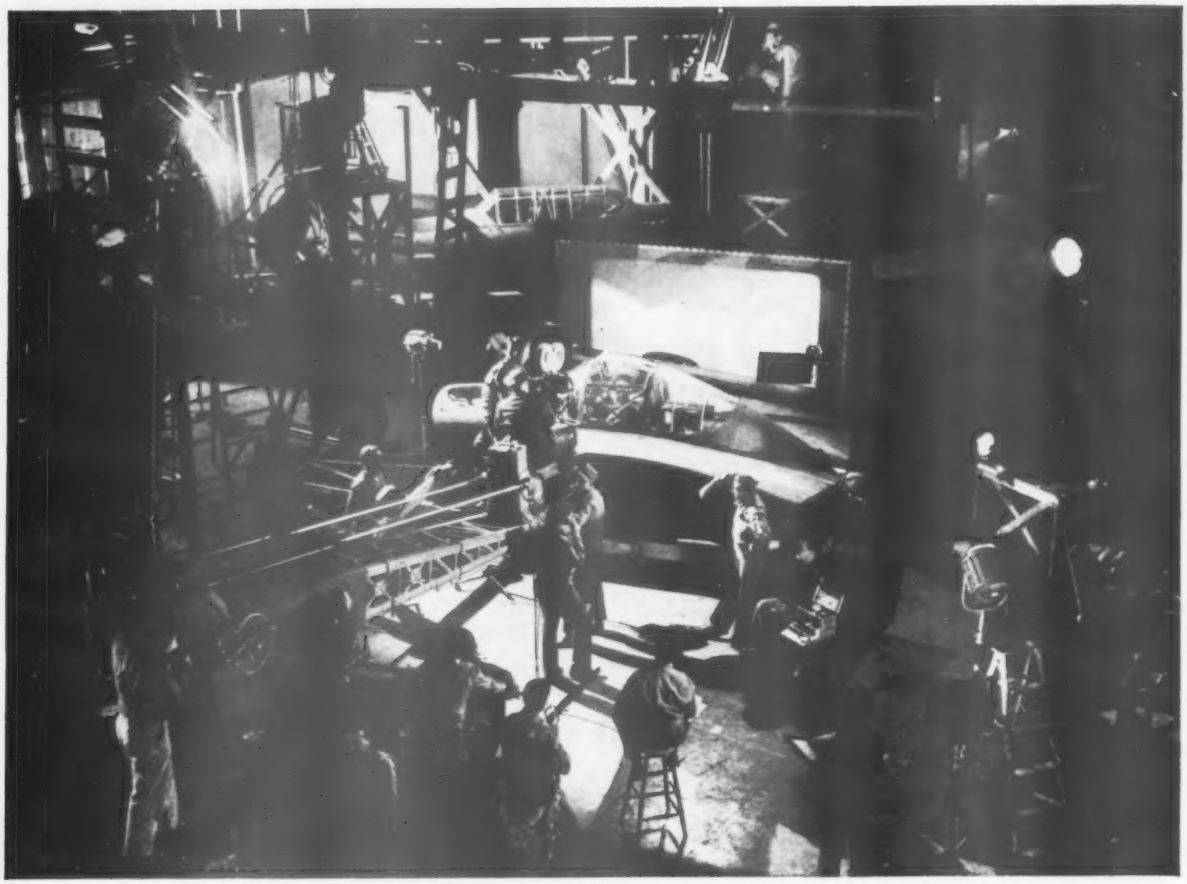
Alkylation unit blends iso-butane and other hydrocarbons into high-octane alkylate.



Mock-up of a Lightning on one of the AAF Unit's sound stages permits close-ups that register pilot's reactions "in flight."

AAF FILM UNIT

By RICHARD O'CONNOR

Staff Writer, Los Angeles Examiner

Maj. Frank Clarke, commander of the movie echelon, flies old Boeing P-12 for stunting.

NOT so long ago the Hal Roach studio in Culver city, Calif., was the confused realm of flying custard pies, slapstick, "Our Gang" comedies and squadrons of wild-eyed comedians. For years the five sound stages of the movie lot had been the capital of screen jesters. In 12 days a great change was wrought. Up went the sign over the front offices: "Army Air Forces First Motion Picture Unit."

That was October 1, 1942. Moving in under the command of Lieut. Col. A. Paul Mantz was a newly-recruited group of Hollywood stunt pilots, aerial photographers, movie directors, writers, actors and technicians. They had a double mission: to produce training films which would cover every phase and problem of instructing all branches of the AAF, and to train combat photographers.

Twelve days later, the newly-activated unit, which is now known as the 18th AAF Base Unit (Motion Picture Unit),

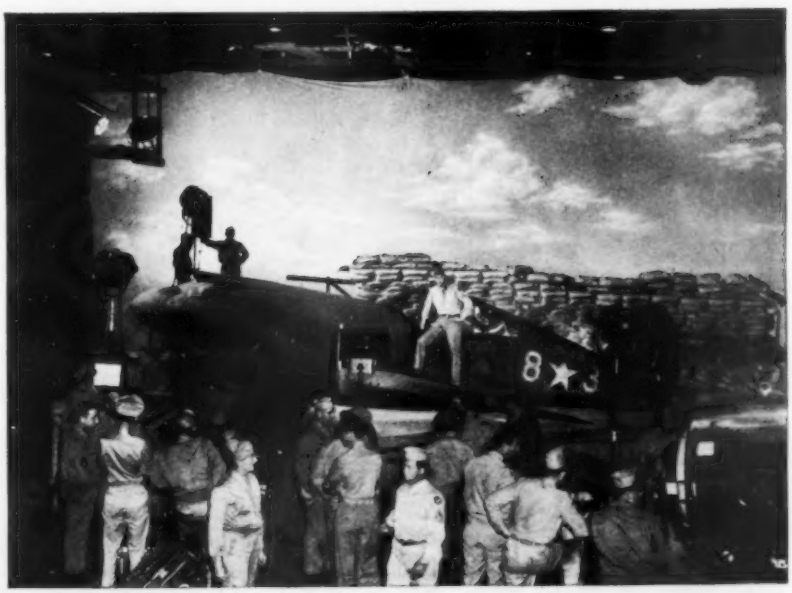
"How to Land and Live" movies show the use of cowling reflectors. 'chute tent, tin-can stove.

Movie industry's answer to AAF training problem is a series of humorous air-combat film lessons.

began its first picture, a celluloid brochure on flying safety called "Learn and Live." Writers and research workers gathered material and background for the film, a flight echelon was established at Metropolitan Airport to obtain aerial sequences, and actors were placed before the cameras to record dramatic sequences on the ground. The story was simple but effective: a flying instructor went to "Pilot's Heaven" to ask St. Peter how and why his charges had arrived there. The picture then "dissolved" into sequences showing the 12 fundamental mistakes leading to crashes. One sequence, for example, showed a day-dreaming bomber pilot who forgot to release his landing gear.

While this film was still in the shooting stages, the unit received an urgent request to turn out an identification film on the *Warhawk* and the Japanese Zero.

(*Continued on page* 106)



Sound stage set for "advance-base" close-ups. Plane is an imitation P-40 faked by studio.

Do Flight Engineers HAVE A FUTURE?

By L. J. BORDELON and JAMES J. HEATLEY

Chief Flight Engineer
Consolidated Vultee Aircraft Corp.

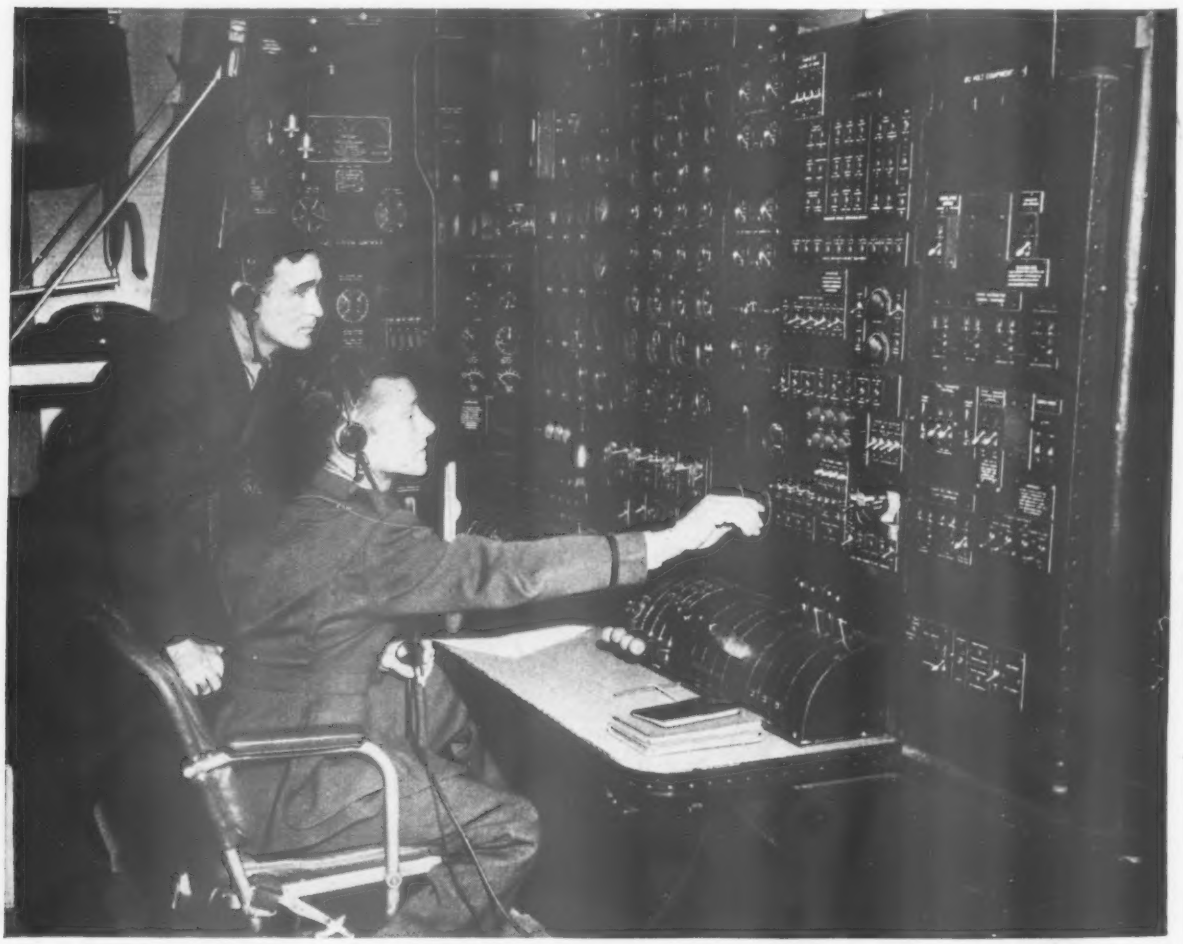
Operations Engineer
American Export Airlines, Inc.

FLIGHT personnel requirements for the globe-encircling operation of war transport planes may produce a new post-war profession—flight-engineering. The flight engineer has been with us for some time but he has flown on only a few international transport operations and on no commercial flights. Prior to the war, long-range transport operation was the exception rather than the rule, and few aircraft were designed to accommodate a flight engineer. His status as a crew member has increased in importance in ratio to the growth in equipment size and the necessity of maintaining transoceanic supply lines.

Today, flight engineers in war service and flying company-operated planes are asking: Where is this job going in the post-war period; how big will it be, and what sort of men will it require?

With our new global concept of air transportation, it seems obvious that the development of larger and more complex multi-engined aircraft has only begun. And it is this trend in aircraft design that has already necessitated flight engineers on Army and Navy and contract transport planes.

Civilian transport operations did provide for such a crew member as early as the late 20's but only in foreign operations where mechanics were not available at intermediate stations for refueling and service. In reality, this flight mechanic was just a lucky ground mechanic who went for a ride. His responsibilities ended upon take-off and were resumed only upon landing. There was no flight engineer's station, sometimes not even a seat for the poor mech. But gradually this groundling became interested in flying. He found minor flight duties to perform—checking instruments when the pilot was otherwise occupied, helping to switch on lights, adjust throttles, or hand-wobble fuel when a pump gave way. Quite naturally there developed the combination man—the mechanic-pilot who could take his turn at the controls when his assistance was necessary.



Two Navy engineers adjust controls of the dial-studded flight engineer's panel aboard the giant flying boat, the Martin Mars.

Science of flight control offers a good future for skilled flight engineers on tomorrow's airliners.

Power setting is computed by engineer from charted data on his cruising control chart. The fuel consumption rate is also chart-computed by the flight engineer on all flights.

Vigilant checks of all fuel lines and valves while aloft is but one flight engineer duty. Periodic inspection of all other vital lines and gauges is also required during long trips.

The combination man did not last long because advanced aircraft design tended to demand increased specialization of crew members. In 1931 the four-engined Sikorsky S-40 provided a jump seat for the flight mechanic between and aft of the pilot and co-pilot positions. Although he still had no "home" of his own, he did have access to all controls and instruments available to the pilots. He could help start engines, change engine powers, adjust mixtures and keep a constant watch over engine r.p.m., temperature and pressure. Pilots soon admitted that this technical service considerably reduced the complexity of their jobs. More of the pilot's attention could be directed to navigation, meteorology, radio and actual flying, and there was a measurable reduction in pilot fatigue.

The Sikorsky S-42, which went into service in 1934, provided the flight mechanic with a station all his own—although he had to ride backwards and jointly share throttles and mixture controls with the pilots. His own instrument panel contained head temperature and oil pressure gauges, the fuel valves and gauges, carburetor controls, etc., but he did have to twist around and look over the pilot's right shoulder for r.p.m. and manifold-pressure information.

Glenn L. Martin's Model M-130 placed the mechanic's station back in the cabin and gave him a complete set of instruments. Though some were duplicated—the tachometer and manifold pressure gauges—on the pilot's panel, the mechanic had complete control over the fuel system and carburetor heat. The hand pump for braking the propellers was also located at this station. It all added up to quite a responsibility which the mechanics met with credit during pioneer flight operations over the Pacific in 1936.

When the first Boeing B-314's were delivered in 1938 it appeared that the day of the flight engineer had really arrived. He was even given an upholstered chair. All controls previously established in other aircraft were provided and, in addition, there were throttles, feathering buttons, manual mixture controls, fuel analyzers, flow meters, etc. The flying boats also provided wing walkways and removable firewalls in the engine nacelles which permitted minor engine repairs in flight. His equipment now was such that for the first time the flight engineer could begin to save his weight in gasoline.

In 1942 American Export Airlines put into North Atlantic service the Vought-Sikorsky VS-44, the first aircraft designed for non-stop Atlantic operation. These long-range flying boats added engine starter buttons, magneto switches and feathering controls to the equipment the flight engineer had already accumulated.

That all this progress was made entirely on flying boats is explained by the fact that the boats were first used in long-range and foreign operations. Now that four-engined land planes are comparable in size and range, their need of flight engineer's stations also has become apparent.

Just when does the service of a flight engineer become necessary? This question is puzzling many an airline operator as well as aircraft manufacturers. The answer may best be determined by reviewing the functions performed by the flight engineer. They include—

1. Servicing at stations where there is inadequate ground personnel, or the supervision of that ground service where personnel is adequate. In many foreign countries labor regulations are such that only native mechanics may be employed.

(*Continued on page* 103)

By FRED HAMLIN

Chosen Instrument Again

This spring should see the final show-down in the chosen-instrument-vs.-free-competition battle over foreign post-war air transport by U. S. lines. . . . After a long lull, during which the free-competition advocates seemed to be winning, chosen-instrument partisans have taken the fight to Congress for decision. And on The Hill they are not without friends. . . . Senator McCarran would create one foreign U. S. operation—the All-American Flag Line, Inc. Backing him is the Senate's post-war aviation sub-committee under Senator Bailey, long a campaigner for monopoly in foreign operations. Both showed signs of renewed strength during the past few weeks and have again brought the fight to the public notice. . . . Opposition counter-attacks include recent statements not only by the Civil Aeronautics Board, which has shown signs of favoring competition, but also anti-monopoly declarations from State, Justice, Army and Navy. The opinions of the armed forces were considered so devastating by the chosen-instrument partisans that they tried to suppress them. . . . Chosen-instrument advocates—typified by Pan American—hope, if not to get Congress to favor them outright, at least to stop the Board from granting franchises to more than one airline before the basic issue can be resolved. . . . It is difficult to predict what will be the outcome but this can be said: a long-view policy decision should result from the present show-down; and although the opponents are really nip and tuck, as we go to press free-competition seems to be a couple of lengths in the lead.

Rate Cuts

On the home front, the biggest recent blow in transport fields was CAB's New Year's resolution to cut mail rates from 60 to 32 cents a ton mile. Airlines rolled with the punch. Many had plans to pass savings on to airline passengers, as witness American's announcement of a 6.5 per cent cut effective March 1, United's cut of 10 per cent, plus five per cent additional on round trips, and TWA's offer of a five per cent discount to travel card holders. There had been some talk of coordinating these cuts—to prevent varying rates over the same routes and price wars—but when CAB fired its mail-cut proposal, airlines who were ready jumped the gun, too. . . . Upshot is that, while others may announce reduced passenger rates, operators favoring an over-all passenger rate reduction program seem to be making headway. Whether the traditionally individualistic airlines will be able to get together on such a program is anybody's guess. . . . Operators feel strongly that it would be better to cut passenger rates and encourage air travel, at the same time leaving the door open for a rate rise post-war if the high war-time load factor dries up and planes become plentiful. They would like to see over-all reduction in mail rates postponed until big, more efficient post-war transports get into operation. . . . CAB, while welcoming the passenger rate cuts, feels that a big mail cut is timely. . . . Probable outcome: a compromise under which the Postmaster General and the air traveler will both get a slice of the rate-cut melon.

Air Travel Boom

Undoubtedly, everybody's airline is doing all right these days. PCA announced recently that it carried as many passengers in 1944 as were carried by all the airlines of the nation 10 years ago. Almost daily the CAB announces extensions of domestic routes. TWA is expecting to have between eight and 10 *Constellations* on domestic runs by mid-summer, and post-war orders for transports are already beyond the two hundred million-dollar mark. . . . Word from abroad would indicate that it's the same the world over. Even in France during the German occupation, enormous increases were reported despite huge reductions in equipment. Reports from Paris reveal that in 1943—with only 123 transports, as compared with 385 in 1938—passengers carried jumped from 28,000 to 109,000, with freight tonnage up from 1,700 to 2,500. . . . Which reminds us that ex-Vice President Wallace said recently that air travel will be one of the greatest post-war booms, and its chief enthusiasts—he thinks they will be school-marms—will do more toward spreading the values of travel by air than any other one group. . . . Incidentally, so many transports have been returned to private operators by the Army in recent months that the grand total is almost back at pre-war levels. If you want to buy one of the big fellows—you have to be properly certificated—here's the price list: Douglas *Skytrain*, $80,000; Douglas C-39, $40,000; Lockheed *Lodestar*, $56,000; Lockheed *Hudson*, $40,000; Beech *Voyager*, $48,000, and Cessna *Brass Hat*, $12,000. . . . We should add that the *Voyagers* cannot be delivered until after VE Day plus time enough to get over the celebration; and neither the *Hudson* nor the *Brass Hat* have as yet been certificated by CAA.

Plane Sales

Speaking of planes for sale, look for a continuing trend away from the competitive bidding method of unloading surplus Government lightplanes as the result of meetings held in Washington the past few weeks. Probability is that some—not all—of the Federally-owned planes coming to market will be sold at fixed prices to fixed-base operators, who in turn will be permitted to add to sales prices for repairs and commissions, always under a specified ceiling. . . . Reason for the new trend is that putt-putts sold out of the War Training Service program met with eager bidders who paid better-than-average prices because of the demand. But fixed-base operators, notably J. Wendell Coombs, president of the Aeronautical Training Society, point out now that the primary trainers coming up for sale will not be in such demand because of higher original cost and higher upkeep. . . . ATS members would like to keep themselves in business till post-war models reach the market, but at the same time avoid high cash gambles on speculative stock. . . . Manufacturers seem inclined to go along for the time being, since their future sales will depend on going and healthy fixed-base operations. . . . Sympathetic handling of the problem is indicated by Lieut. Col. William B. Harding, whose background includes lean years as a fixed-baser before the war, and whose authority with Defense Plants Corp. now empowers him to trend the sales to the best advantage of the operators and the general public.

General Elliott

For what adds up to years now, we have become more and more curious concerning the aviation career of the President's son, Elliott. It is a curiosity that was not dampened by the War Department and the AAF, who have generally treated his goings-on as a top military secret. And it was heightened recently by the travels and adventures of his dog,

(*Continued on page* 136)

The 'Mail Order Command'

Huge control board helps ATSC follow movement of millions of items to war theaters.

By MEL MEYERS

ATSC stocks and supplies world battlefronts with more than half a million different items.

RECENTLY a Washington newspaper columnist made the statement that no one knew how much of what materiel had been transmitted overseas by our service commands. Obviously the columnist had never taken the trouble to find out that there is such a thing as statistical control in, for instance, the Air Technical Service Command—and that statistical control personnel could give exact data (if it weren't restricted) on everything that's been shipped and when and how. As a matter of fact, there are data files for every requisition that has ever been made upon the Command.

ATSC stocks over half a million different items. That's not "big business;" it's "super-business"—especially when comparison reveals that the largest mail-order house in the world inventories only about 46,000 items. But providing historical information on the movement of materiel to overseas theaters is only a minor function of statistical control. The major job is to maintain a constant check on every step in the request for the transmission of each item that goes to areas abroad.

There is perhaps no better place to watch this system at work than in the Office of Statistical Control at the headquarters of the Atlantic Overseas Air Service Command at Newark, N. J. AOASC has two other bases—one at New Orleans, another at Norfolk, Va., the installation at Newark being the largest of

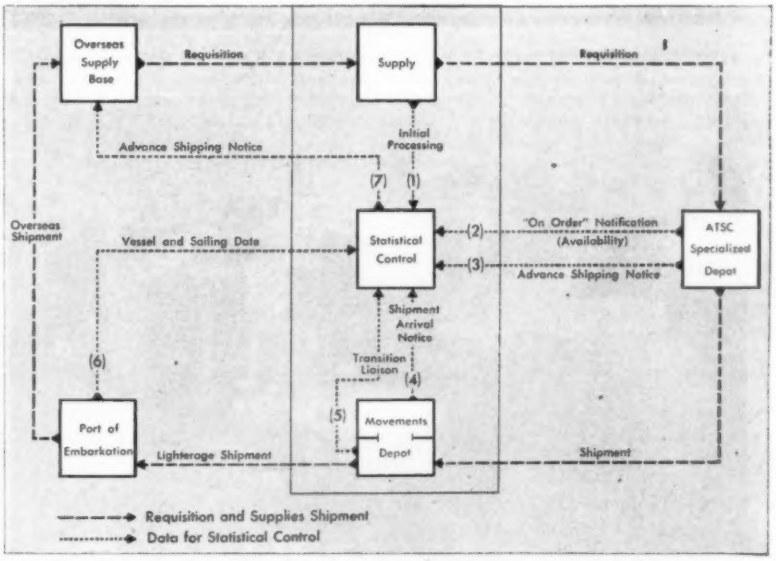


Chart shows how AOASC controls and fills requisitions at Intransit Depot No. 5.

Loading air freight on an ATC plane at Atlantic Overseas Air Service Command, Newark.

Mustangs (foreground) and Thunderbolts, processed and awaiting shipment by AOASC.

Soldiers and civilian employees at work in statistical control section of AOASC.

the three. All three bases are commanded by Brig. Gen. William E. Farthing, who was commander of Hickam Field in Hawaii at the time of Pearl Harbor.

The 3,000-acre Newark installation was the busy Newark Airport until January 6, 1942, when the Army Air Forces took it over. Ideally equipped to get the right material to the right place at the right time, the base has rail, water and air terminal facilities. From Intransit Depot No. 5, the freight-transmission heart of the whole Newark installation, there now passes a daily average of from 4,000 to 5,000 huge cases of organizational material. At the height of activity, when the invasion of France was impending, as many as 10,000 cases a day were issued from the depot. Fully 25 per cent of all cargo sailing out of the Port of New York originates at the depot and the 35 flights operated by the Air Transport Command carry out each month air cargo totaling some 8,000,000 pounds. The ATC uses *Commandos*, *Skytrains* and *Liberator Expresses*.

What the Air Forces call "organizational material" is everything (except for the planes themselves) that keeps 'em flying —everything from a fast rescue boat 104 feet long to a radio crystal as thin as a cigarette paper. The term refers to landing gear, belly tanks, tires, flight instruments, radios, batteries, oxygen masks and hundreds of other replacement parts used to maintain planes in flight. It means gasoline service trucks, crash trucks, communications equipment, machine-shop equipment, lumber and thousands of other items that add up to airfield maintenance. It means cots and blankets, shoes and socks and all that goes to maintain the soldier himself. And it means a host of things that we normally associate only with business enterprise, but which are just as necessary to modern military existence—everything from typewriters and filing cabinets to pads and pencils.

Even before organizational material makes its appearance at an AOASC base for transmission overseas, control is already in effect back at Wright Field, Dayton, O. headquarters of the Air Technical Service Command of which AOASC is a unit. Radiating out from the Wright Field base are various carrier lines that terminate at ATSC specialized depots all over the country. These are the supply bases that actually stock the materiel for the AAF. Constant control of stock is concentrated at the Dayton headquarters. Here one finds hundreds of feet of cabinets that hold the Kardex system of stock control developed by officers of the ATSC in co-operation with Remington Rand. It is a system that accounts for every single item. A single split card contains all of the following data on each item of organizational material handled by the ATSC: where the piece of property is to be issued, when it is due, quantity requested, how much of it is in stock, how much on order, quantity all ready for shipment, quantity requiring processing before use, and other similar information. Regardless of where an item may be, there is a complete posting on it.

This tight control of *stock* is matched

(*Continued on page* 148)

PLANE DESIGN FUNDAMENTALS

Weight studies indicate the life-span revenue of a Douglas DC-3 airliner to be $37.50 per ounce—more than the value of gold.

By A. L. KLEIN

Design Consultant, Douglas Aircraft Co., Inc.

Rapid interchangeability of accessories is desirable but safety and weight are more important. Designer proposes all parts and devices be made "fail safe."

THE three underlying fundamentals of aircraft engineering that must influence every design decision are: safety, weight and serviceability. Airplanes have crashed because the pilot dropped a microphone or because he happened to kick a small lever in the floor. Several accidents have been due to the malfunctioning of comparatively minor accessories.

Young engineers are terribly shocked to discover that their brain children are kicked around and given the same type of care as are tools in a second-hand automobile. The sound and only safe attitude to take in the development of any gadget for an airplane is to assume that it will be neglected, lubricated with the wrong oil, maladjusted and misused. If the device will still function under these circumstances then it may be satisfactory; if not, it will be potentially dangerous.

In many cases designers have made parts so that it is impossible for inspection personnel to determine if they are properly installed. Failures due to the omission of necessary bushings, bolts, etc., can properly be blamed upon the carelessness of the designer. He must make sure that there is only one possible method for assembling the component and that the proper one. Assembly and adjusting sequences which involve procedures in different locations in the airplane are invariably dangerous since it is very easy for some of the items to be left unattached or improperly adjusted.

Wide use of aircraft cable controls in place of push rods and torque tubes is another example of the necessity of avoiding mechanical parts that can fail suddenly and without warning. Some of the services tried to force a wider use of push-pull controls but the hard facts of military experience forced them to revise their requirements and to insist on cables. In airline transports, where excellent supervision and carefully kept records are available, push rods have given continual trouble. Push rods after failure frequently form rachets and so violate the principle of "failing safe." Steel cable is an ideal type of aircraft device: it is a multiple structure; has internal dampening and long before it fails completely it gives an easily detected indication of potential danger. Cables seldom jam and therefore permit operation of the mechanism by alternate or auxiliary means.

Since any device or part will fail sooner or later it is imperative that the designer make such failures non-catastrophic. Landing gears need auxiliary lowering means, brakes need stand-by power, and every engine has two magnetos. All devices essential to the safe operation of the airplane must not only have standbys but they should not depend on the satisfactory operation of auxiliary power.

High standards of engineering integrity developed by aircraft manufacturers must be applied to accessory devices for aircraft. Practically no commercial devices are tested through the whole range of temperatures, pressures and vibration common on airplanes. The principles of safety after failure are not ahered to. Practically no aircraft electrical devices have two limit switches, though many of them have been wound up into knots through limit switch failure.

The practices of many designers in not detailing the assembly of their components is one of the principal causes of the unsatisfactory reliability of their equipment. I have yet to see a radio set mounted on a set of shock mounts in such a manner that the mounts do not defeat their own purpose by multiplying the vibration rather than reducing it.

In studying the effects of weight in aircraft it is convenient to use commercial statistics. There is much argument about the proper methods to be used for calculating the value of weight in commercial

This article is a condensation of a paper presented recently at the National Aeronautical Meeting of the Society of Automotive Engineers in New York.

airplanes. The methods used and results are given below:

THE VALUE OF WEIGHT

(The data used are all pre-war.)

Assumptions

Revenue per passenger mile: $.05 per 200-pound unit.

Scheduled Cruising Speed: 160 m.p.h.

Service life: 25,000 hours

Passenger load factor: 60 per cent

Calculations

Distance traveled by airplane during its life:

160 m.p.h × 25,000 hours = 4,000,000 miles

Revenue expected per pound mile:

$$\frac{\$.05}{200} = \$.00025 \text{ lb. mi.} = \frac{1}{40c} \text{ per lb. mi.}$$

Potential revenue on one pound during life of the airplane: $.00025 per lb. mi. × 4,000,000 mi. = $1,000.00

Actual revenue at 60 per cent load factor will be:

.60 × $1,000 = $600 per lb., or $37.50 per oz.

Gold is $35 per ounce.

Note that the results are expressed in terms of earning power. The value of $600 per pound is fairly representative of Douglas DC-3 operations; in the post-war period the rates will probably go down and the cruising speed up, with the two effects tending to counteract each other.

This value for weight is so high that it justifies an incredible amount of work in engineering and in the shop. A simple calculation indicates that a saving of 250 pounds per airplane is worth more than the present first cost of the plane. The table makes obvious that the cost is not in the weight itself but in transporting the weight for 4,000,000 miles. Unfortunately, airline operators will not recognize such values for weight saving. Most airplane factories will speed at least $10 to save a pound of weight without question, knowing that the value of the weight is greater than the cost of saving it.

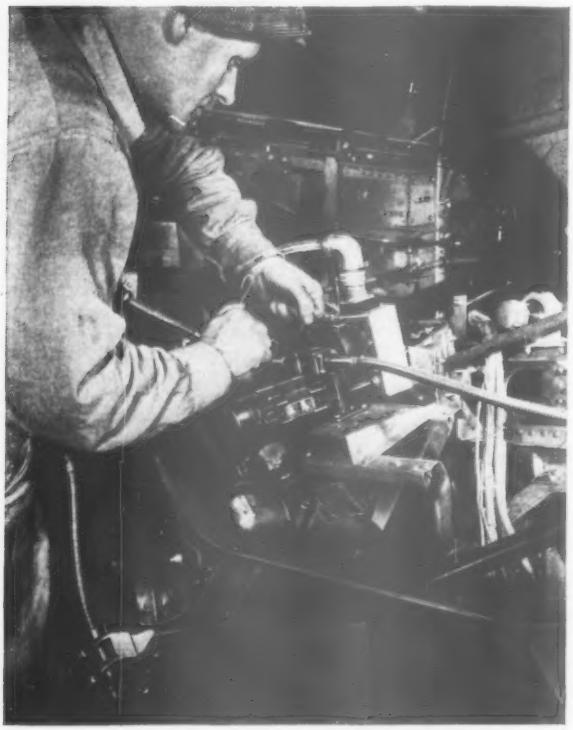
Changes other than such direct weight savings are of equal importance; in most cases quite small changes in cruising speed have a tremendous effect on the earning capacity of the aircraft. On a modern transport, a small device weighing 40 pounds saved 200 pounds in fuel per flight by increasing the cruising speed 1½ m.p.h. The instance studied was a long range case since at 700 miles the device broke even as regards weight saving, while for shorter ranges it represented a loss, causing a decrease in pay-load, an increase in first cost, higher maintenance and less safety.

Engineers frequently are confused by talking only to maintenance personnel and may get a false idea of the relative values of many maintenance items. It takes about two hours to clean an airplane after a long trip and if all the necessary items can be completed comfortably in that time, it is sufficient. Quick interchangeability of parts or devices is also desirable but safety and weight are more important. Interchangeability is required when devices are of poor reliability. It is easy to show that a higher utilization of the equipment owned will be achieved by assembling most of the spares into aircraft and flying them. Spares in the stock room represent only an expense; when they are flying they are earning. I feel that airplanes will become more and more like ships and that spares will tend to become more in the nature of raw material than parts. Note that naval vessels and the newer merchant ships have no hatches for removal of engines or boilers. The cutting torch is used to remove them.

During the development of airplane design it was found that the weight of any item, however small, was important. A tendency on the part of many engineers new to the industry is to believe that small items are unimportant and weight saving is necessary only on the larger ones. To indicate the relative unimportance of parts commonly thought important, a rough weight breakdown on the Douglas *Skymaster* is given below. From this table one can see that the "*primary* structure is of *secondary* importance." The design of accessory and equipment items furnishes a ready field for weight savings that collectively might be worth far more than the entire cost of the equipment. A good layout of the airplane's equipment will save more weight than the use of the latest and fanciest alloys together with the best possible structure.

Structural group: wings, tail, fuselage	34 per cent
Power plant: engines, propellers, controls, accessories, nacelle and cowling, fuel and oil system	36 per cent
Fixed equipment: surface controls, hydraulics, electrical communications, instruments, de-icing, furnishings	18 per cent
Landing gear and tail skid	12 per cent

(*Continued on page* 152)



Superfortress cowl flap actuating devices are included in the 36 per cent of total plane weight charged to a power plant group.

Racks of tubing in varied sizes consigned to Flying Fortresses illustrate how aircraft assembly components add to unseen weight.

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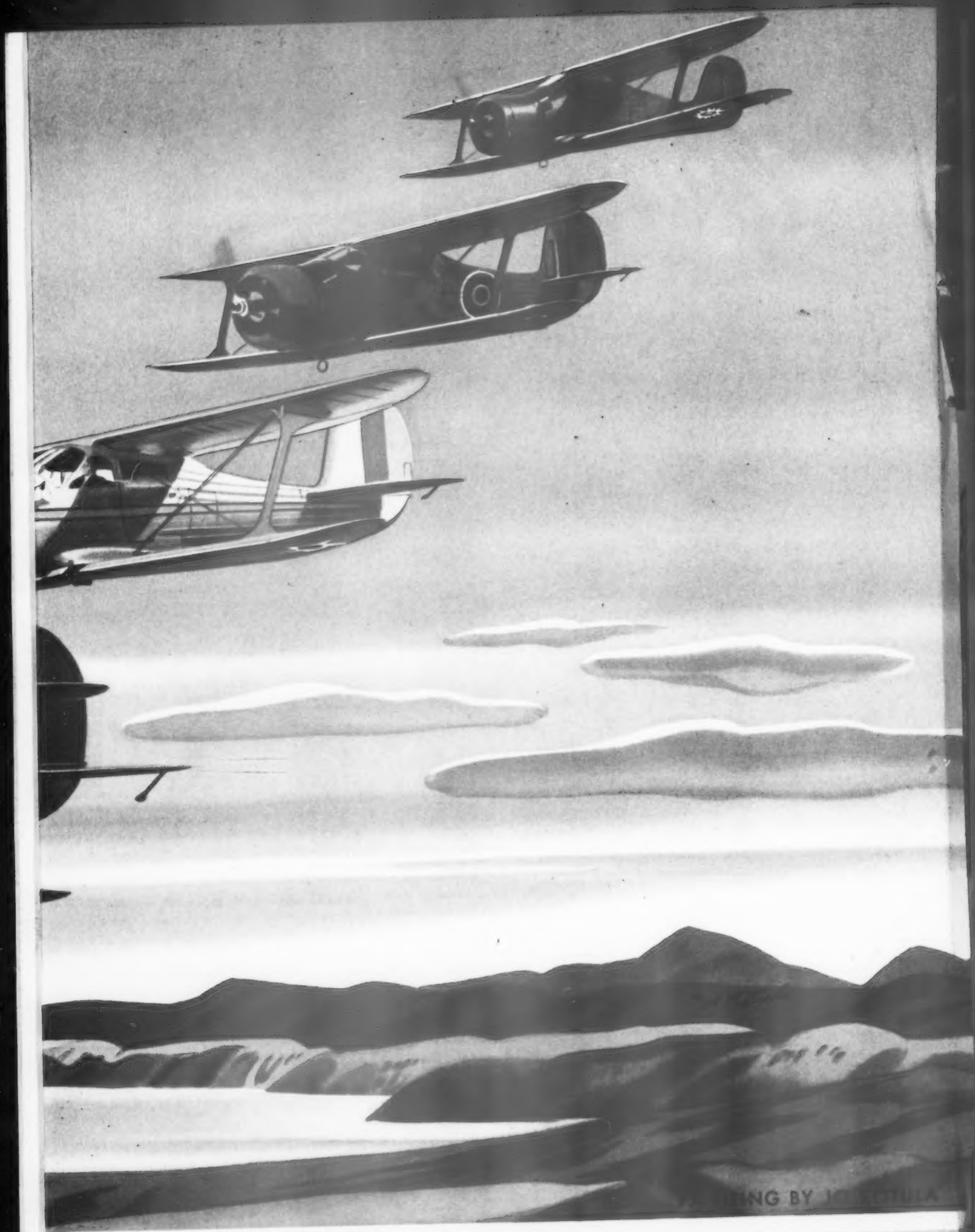

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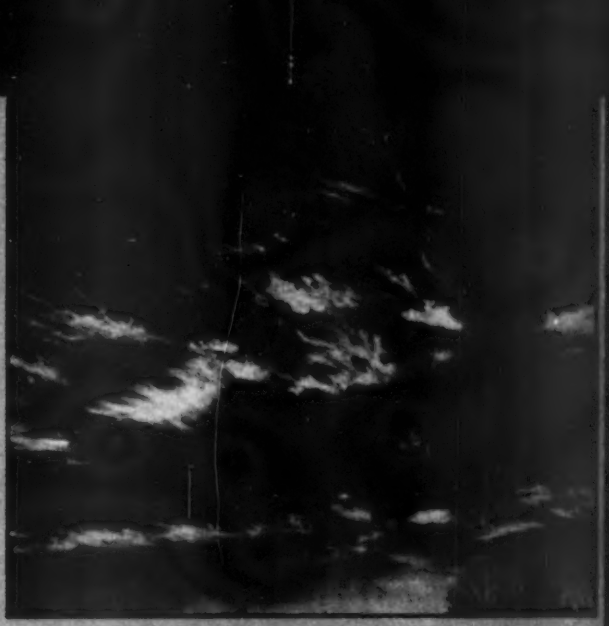
Know your *Clouds*

CLOUDS supply valuable weather information to the pilot who can "read" them correctly. They are identified in four "family" groups, (1) high clouds, or cirrus, generally above 20,000 feet; (2) middle clouds, altocumulus and altostratus, which form between 20,000 feet and 6,500 feet; (3) low clouds, stratocumulus, stratus and nimbostratus types appearing from 6,500 feet to very near the earth's surface and (4) vertically developed cumulus, or "woolpack" and cumulonimbus "thunderheads" ranging from 20,000 feet to 1,600 feet.

While observation of various cloud decks or systems is helpful in foretelling approach or passage of cold and warm fronts, many factors can cause an expected weather condition to change or even reverse itself. A front is a line of discontinuity created by one air mass overtaking or displacing another. Normally, fronts are named "warm" or "cold" depending on the air mass moving in. While actual frontal areas have cloud cover giving precipitation in some form, i.e., rain, snow, hail or sleet, the clouds in advance of the front can only *aid* in predicting and gauging the rate of movement.

Shown here are the cloud types most frequently seen and easily identified in this hemisphere. All pilots should learn to "read" them. Captions indicate a general interpretation.



Cirrus (Ci). Composed of ice crystals whose density determines the degree of transparency. When viewed near the horizon they appear yellowish in color. They normally indicate good weather.

Fractocumulus (Fc). These are low ragged bad weather clouds and are laden with moisture. Only slight precipitation will fall from them while they remain in their cumulus form.

Cumulus humilus (Cuh). This type of cumulus cloud signifies good flying weather. It does not appear to move rapidly, and

Nimbostratus (Ns). Note the Fc roll formation appearing on the horizon. When the air is stable Ns clouds foretell cold front

XUM

Altocumulus (Ac). In the form shown above they are called a "mackerel sky." Presence of this cloud form could indicate approach or passing of a front. Air below is generally stable.

Stratocumulus (Sc). Globular masses or rolls with lines close together at times. Appear soft and grey with darker patches. When part of a warm front advance they change into stratus type.

Cumulus (Cu). The large cloud is developing into a cumulonimbus and indicates turbulent air when part of an advancing cold front. Has strong convective currents beneath, smooth air on top.

Cumulonimbus (Cb). These thunderheads are to be avoided at all times. Air currents within can assume velocities exceeding 300 m.p.h. Generally part of a cold front and indicate unstable air.

Altostratus (As). These clouds accompany a cold front. If the air is stable, precipitation is continuous. The dark patches

This is a line squall. These clouds are Fc in nature and are always part of a cold front when fully developed. They consist of

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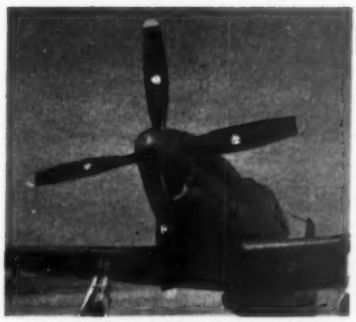

FOUR-BLADE AEROPROP ON P-51 FIGHTER

Aeroprop Advantages—*Lightness* for payload . . . *Strength* for safety . . . *Simplicity* for easy service . . . *Faster Automatic Pitch Change* for flight efficiency . . . *Full Feathering* for engine protection . . . *Engineered* for reliability.

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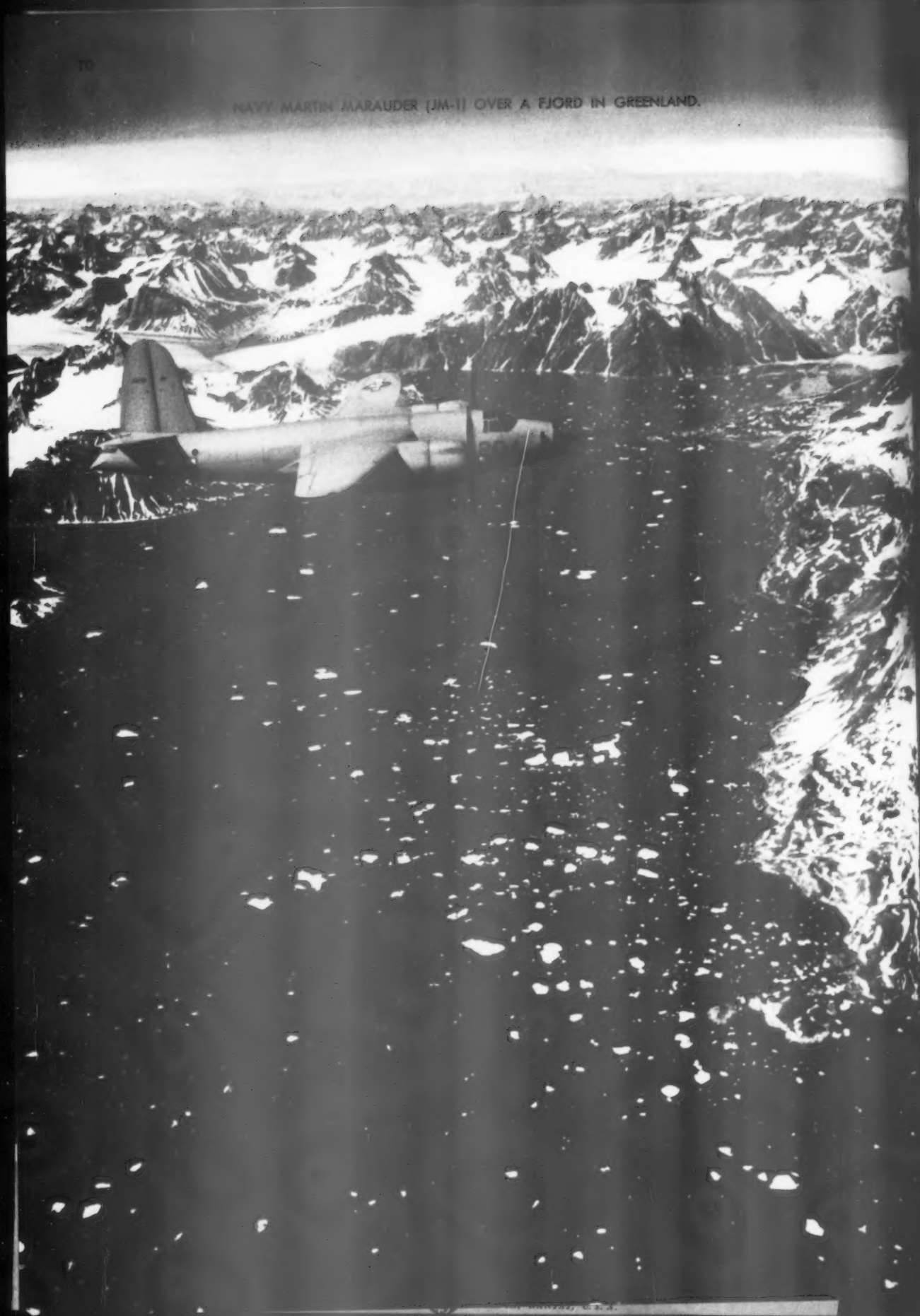

NAVY MARTIN MARAUDER (JM-1) OVER A FJORD IN GREENLAND.

6 big-plane features in your safe, low-cost personal plane . . .

Here is a plane you'll be proud to own . . . that's sporting to fly . . . and a plane you can afford.

It's the new *Swift*, combining into a safe, easy-to-fly personal plane these *six* big-plane features: 1. Bubble-type canopy giving wide vision . . . 2. Extra sturdy, retractable landing gear . . . 3. N. A. C. A. design wing slots . . . 4. Flaps for safe, slow landings . . . 5. Roomy, de luxe cabin . . . 6. Advanced aero-dynamic design, with plenty of thrifty power. In addition, the new *Swift* offers you long range and speed for cross country flying . . . and it can soon be yours to enjoy . . . at less cost than you'd expect. The new *Swift* will be moderately priced in volume production and ready for delivery soon after conditions permit the manufacture of personal airplanes.

The Swift

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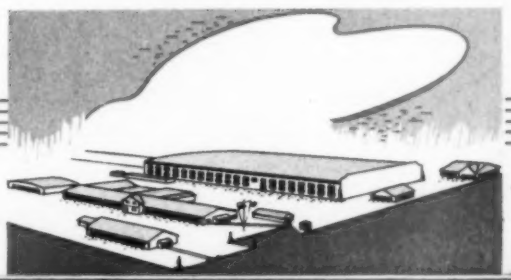

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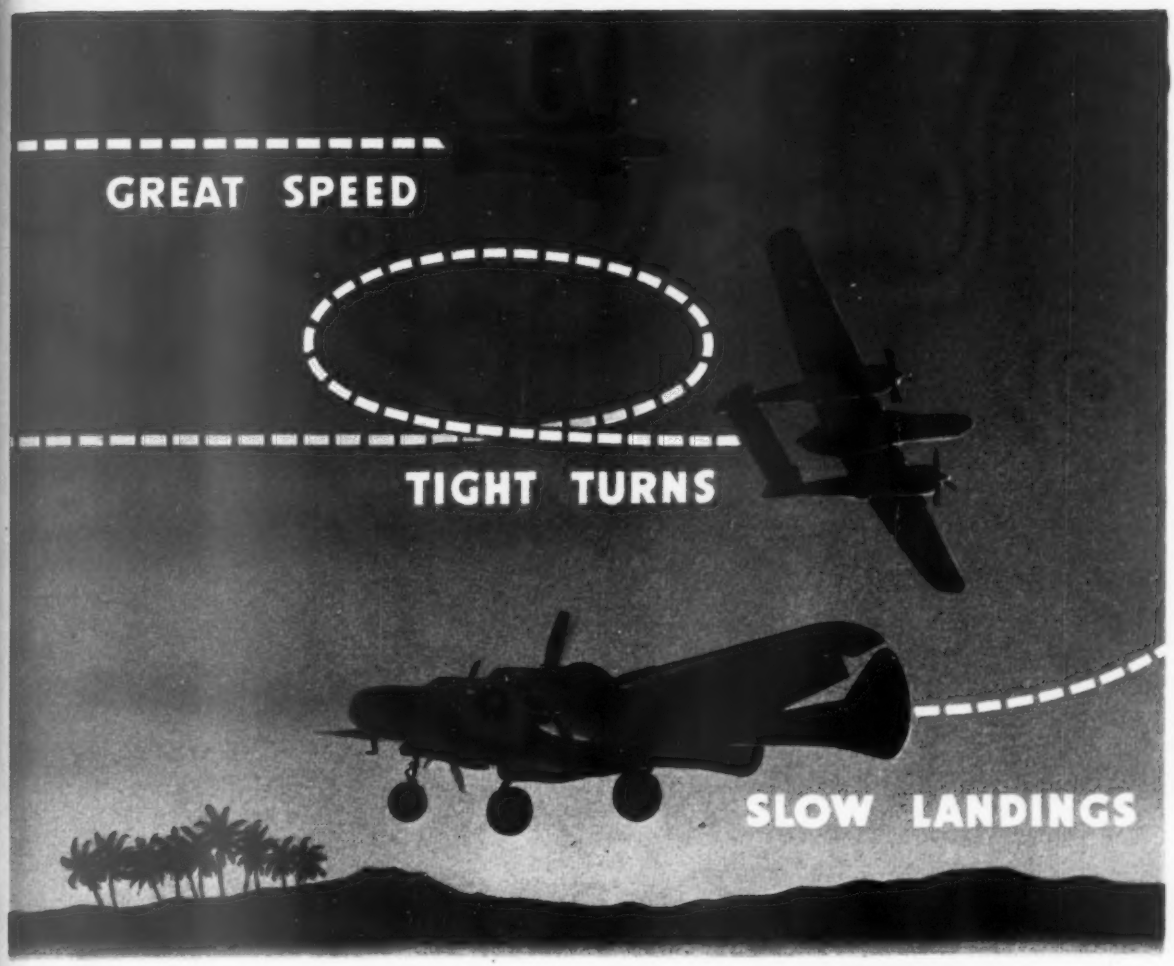
AN RAF HAWKER TYPHOON TAXIES FROM REVETMENT AT ADVANCED BRITISH AIR BASE.



The big Northrop BLACK WIDOW *combines all three —*

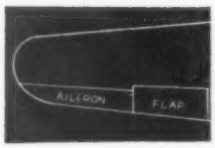
It couldn't be done with orthodox aileron and flap design. But the Army demanded—and got—this all-around performance in the agile Northrop Black Widow.

Retractable-ailerons and full-span flaps, designed and built by the Northrop group, are the secret of this first combination of tight-turning ability and slow landing speed in a large, fast airplane. These revolutionary ailerons leave almost the entire trailing edge of the wing free for flaps. So the big Black Widow lands "on a dime"—at no more than 70 to 80 M.P.H.

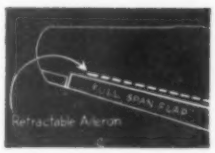
Vital to a night-fighter, think what such reduced landing speeds promise for peacetime passenger and cargo airplanes . . . extra safety . . . air strips only half as long as formerly believed necessary.

The Black Widow, swift as a fast fighter yet big as a medium bomber has many advancements in aerodynamic design. They typify the Northrop-group thinking and building skill that aviation will continue to need in the years ahead.

Northrop Aircraft, Inc., Northrop Field, Hawthorne Calif. Member Aircraft War Production Council, Inc.



CONVENTIONAL DESIGN: *Tight turns* demand "plenty of aileron," *slow landings* call for large flaps. With both controls sharing the trailing edge of the wing, designers were forced to compromise on performance.



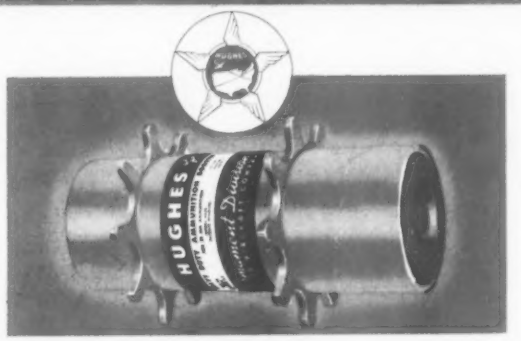
RETRACTABLE-AILERONS in the wing, the first in aircraft history, were created for the P-61 by the Northrop group, making possible a more efficient aileron that teams up with the world's first full-span flap.

NORTHROP *Creators of the* ***Flying Wing*** *and the* ***Black Widow*** *P-61 Night Fighter*

XUM

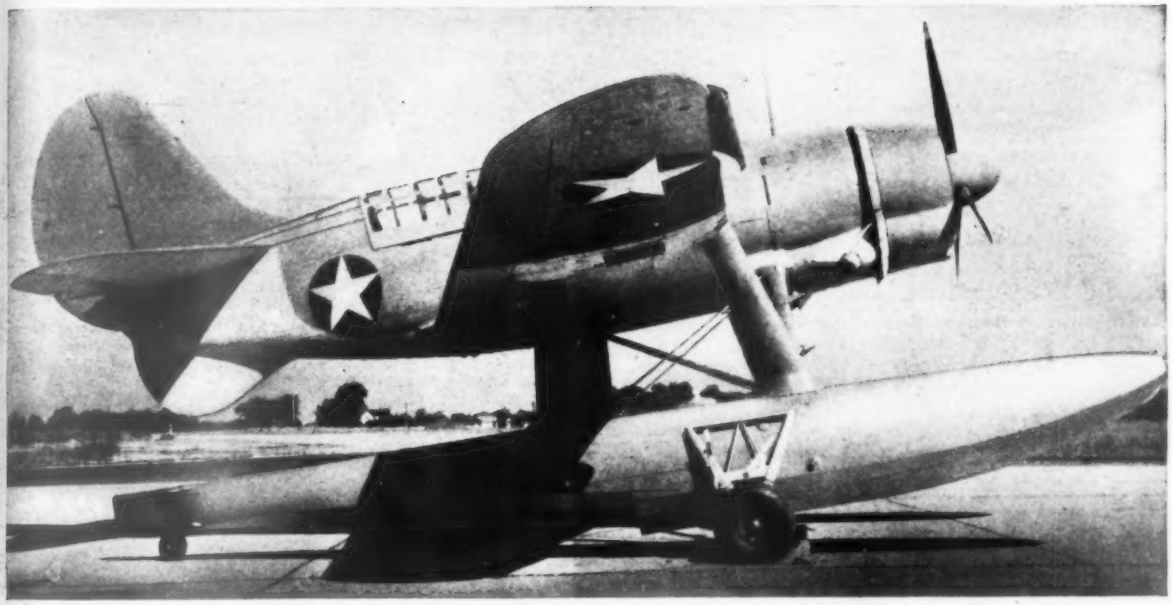
. . . a Big Boost for Big Stingers

In the new Hughes H220 Heavy Duty Ammunition Booster are many revolutionary features . . . reflections of the vital knowledge gained by Hughes Armament engineers from the combat experiences of Allied aerial warriors. Designed and perfected through conscientious research and experimental test, the precision performance of this product assures a continuous flow of 20-mm. ammunition under all combat conditions . . . another Hughes Tool of War designed to provide our fighters every advantage.



Armament Division HUGHES AIRCRAFT COMPANY

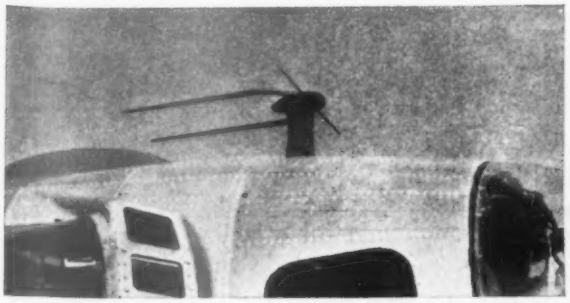
Have You Seen?



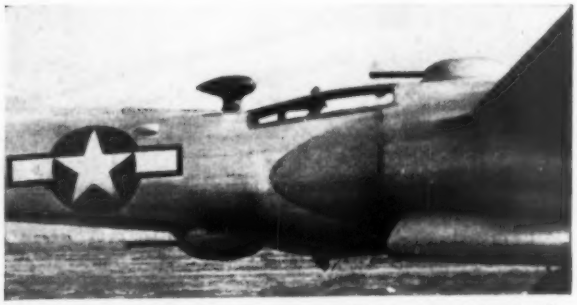
This Curtiss Helldiver (XSB2C-2) was tested on floats by the Navy. As was the case with all combat types thus tested (see page 76), the plane's performance was cut down to the extent that the idea was dropped. Wheels on floats are beaching gear.

Unusual new Gazda helicopter has jet "rudder" driven by 130-h.p. jet engine. Top speed is 180 m.p.h., gross weight 1,200 pounds.

Post-war Taylorcraft design is all-metal Model 12. It is planned to be two-place, all-metal, have 65-100 h.p., cost about $1,200.



Two radios operate off this blind-landing antenna. Slender cross bar is for localizer, while U-shaped piece is for glide path radio.

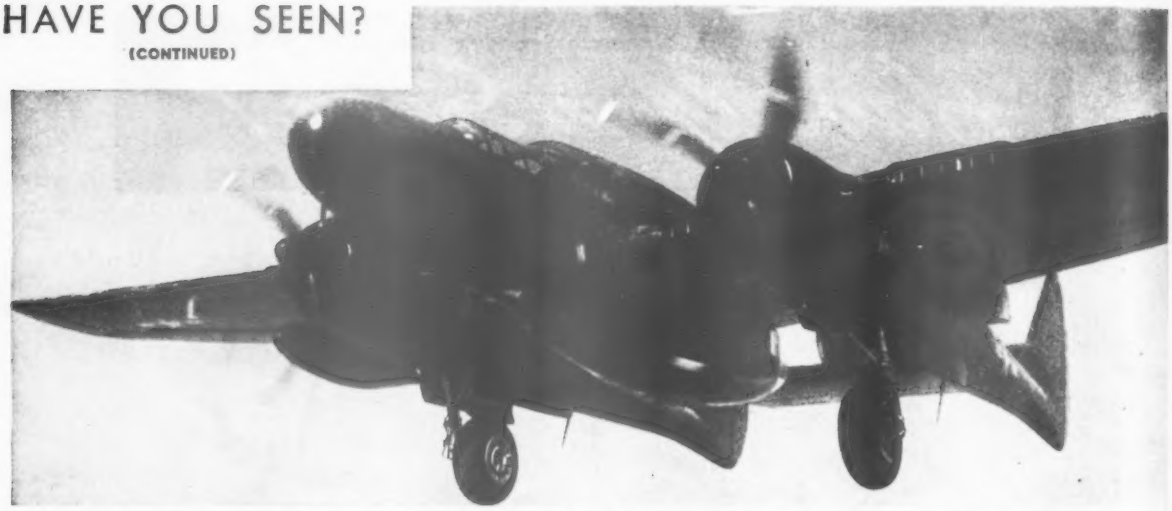


These are top and bottom remote-controlled turrets of Douglas Invader (A-26). Periscope sight projects from fuselage between guns.

XUM

HAVE YOU SEEN?

(CONTINUED)



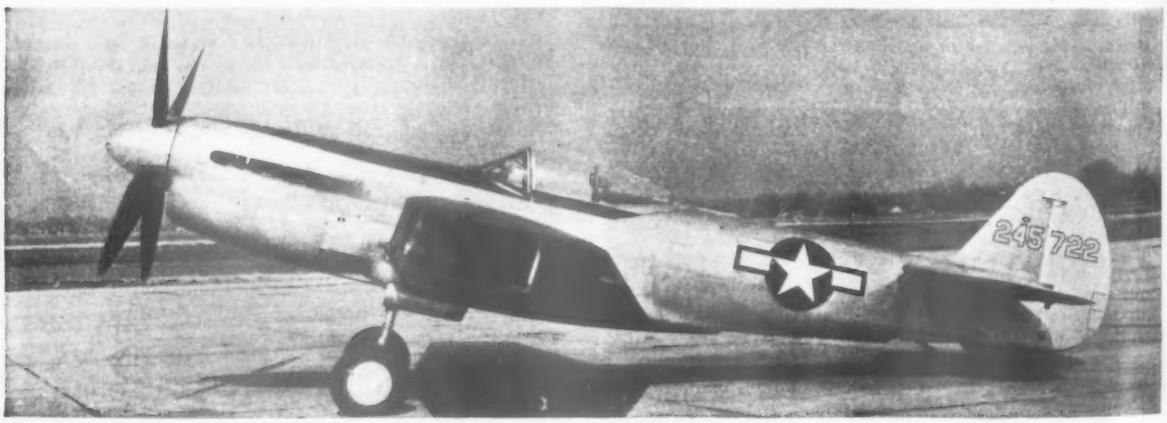
Latest picture of Northrop Black Widow shows external wing tanks. P-61 has radar, four 20-mm. cannon and four .50-cal. machine guns.

Piper L-4X is expected to be basis for postwar design. It has 125-h.p. engine. Span is 35 ft. 9 in., length, 22 ft. 6 in. Top speed: 110 m.p.h.

Tested as a possible seaplane fighter was this float-equipped Grumman Wildcat (F4F). Two auxiliary vertical fins were added on tail.

External fuel tanks have been altered to carry a wounded man. Tanks have transparent nose. Fighters like Lightning thus can carry two men.

To be built under Ercoupe license, two-place Aeronca Chum has 75 h.p., top speed of 120, span of 29 feet. Gross weight will be 1,300 lbs.

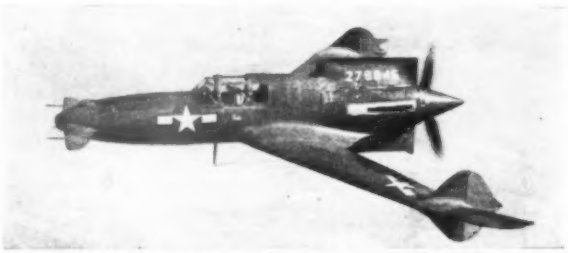


Experimental Curtiss XP-40Q had Allison engine, bubble canopy, square wing tips, four-bladed propeller. Only one was built.

AAF EXPERIMENTS

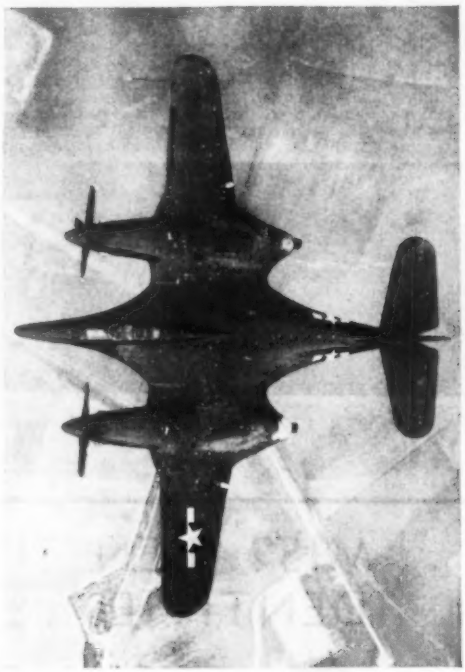
Vultee XP-54 was first shown in FLYING's March issue. It had elevator to lift pilot to cockpit, was made largely of magnesium.

General Motors XP-75 had 2,600-h.p. Allison behind cockpit, contra-props. Originally, a P-51, P-40 and A-24 composite, it weighed 10 tons.

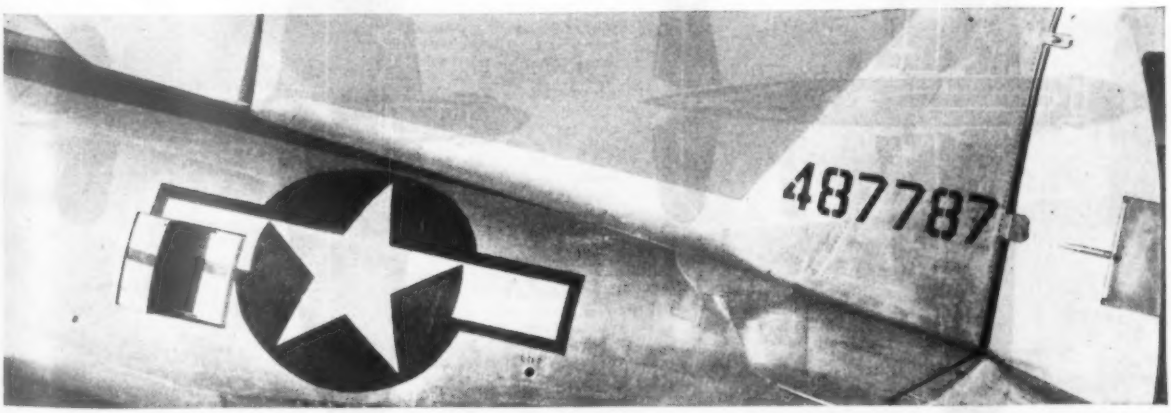


Curtiss XP-55 is tail-first pusher with Allison engine and jettisonable propeller. Elevator is in the nose. XP-55 is still under test.

Bell XP-77 was wooden fighter to combat Jap Zero. It had small Ranger engine, two-bladed prop. Pilots called it "flying engine."



McDonnell XP-67 was cross between flying wing and conventional design. Its two Continental engines appeared to have jet boosters at rear of nacelles. A long-range interceptor, the XP-67 was armed with six 37-mm. cannon. It was single-place and had an airfoil-shaped fuselage. Like all planes in this group, it will not be produced.



An aid to the Thunderbolt's maneuverability, this new vertical dorsal fin will be on all Thunderbolts, starting with Model P-47D25.

FOR IDENTIFICATION

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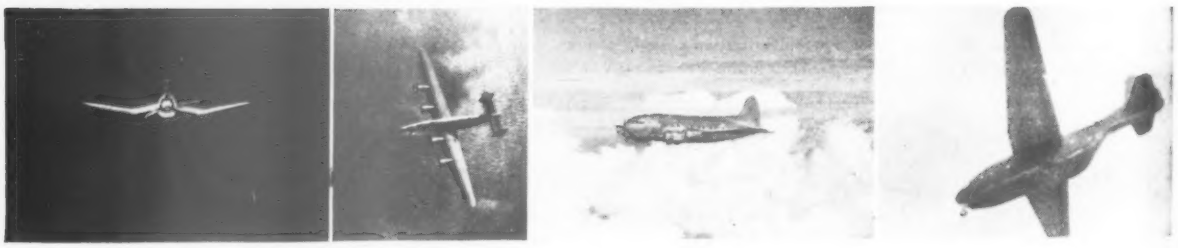
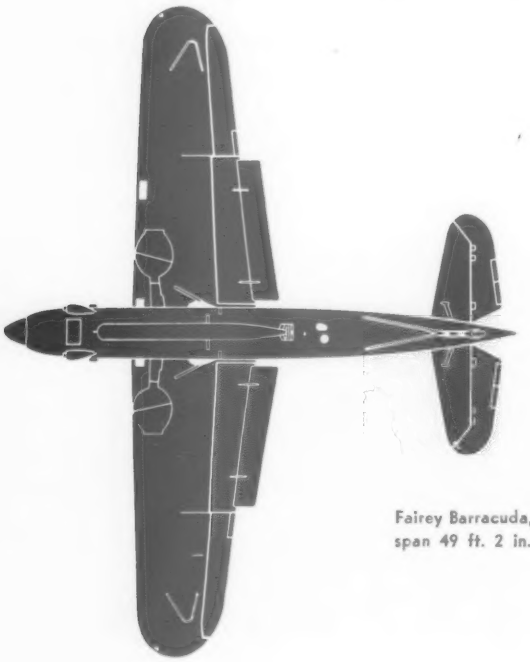


5 6 7 8

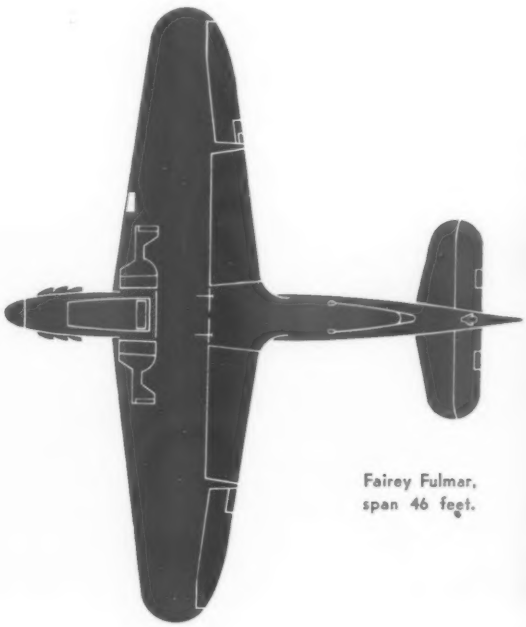
The planes are: 1. Fairey Swordfish; 2. Heinkel He-177; 3. Beaverland Mosquito; 4. Jap Tojo; 5. Douglas XBTD-1; 6. Consolidated Liberator; 7. Boeing Stratoliner; 8. Latsive-Kaufmann Trojan Horse.

MISTAKEN IDENTITIES

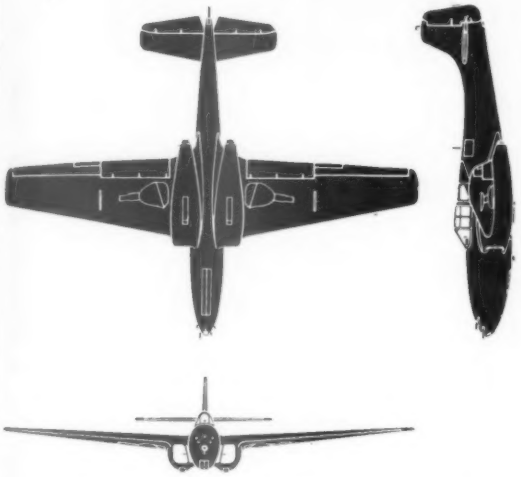
TWO Allied types frequently seen in the European and, recently, in the Asiatic theater are the British *Fulmar* fighter and *Barracuda* torpedo bomber, both Fairey designs. They follow similar lines, the *Barracuda* being distinguished by the projecting trailing-edge flap. They are shown here to scale.

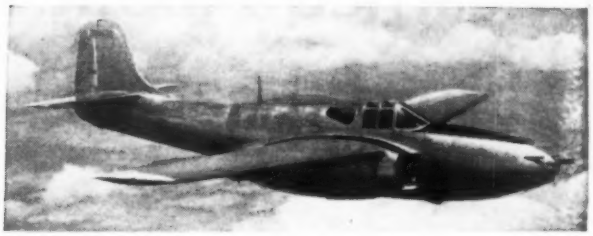


Fairey Barracuda, span 49 ft. 2 in.



Fairey Fulmar, span 46 feet.





BELL AIRACOMET

Technically known as the P-59A, the *Airacomet* now is used as a transitional trainer for jet-fighter pilots. This airplane itself will not be used in combat; other U. S. jet fighters that surpass the Bell fighter in performance already are in production. The *Airacomet* is powered with two General Electric jet engines which can burn the crudest of fuels, including kerosene. Wing span is 49 feet, length, 38 ft. 10 in., wing area, 400 sq. ft. A British source gives the top speed as 575 m.p.h.

NEW CODE NAMES

The Allies have assigned the following code names to enemy aircraft seen in the Pacific area, according to The Aeroplane Spotter:

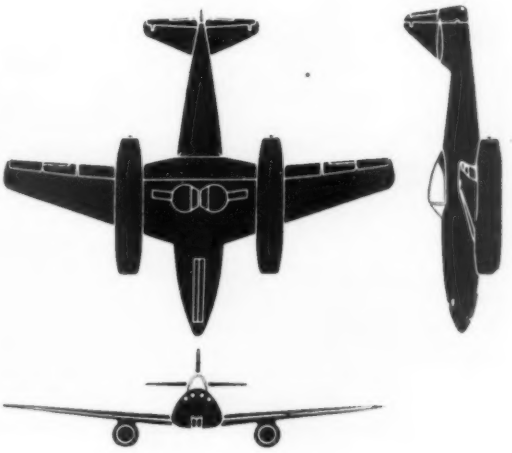
Fred	Focke-Wulf Fw-190
Irene	Junkers Ju-87
Janice	Junkers Ju-88
Mike	Messerschmitt Me-109
Ruth	Fiat BR-20
Trixie	Junkers Ju-52/3m

DOUGLAS XBTD-1 →

The silhouettes at right first appeared in an Australian publication, later in England. The side view was in last month's FLYING. According to a British source, this U. S. Navy bomber-torpedo plane (note new class) has a span of about 46 feet, length about 37 feet, tricycle gear.

MESSERSCHMITT Me-262

This is the German jet fighter doing the most damage at the moment. Named the *Schwalbe (Swallow)*, it is powered with two Junkers Jumo 004 jet engines. A one-place fighter-bomber, the Me-262 has four 30-mm. cannon in the nose, and retractable tricycle gear. Wing span is 40 ft. 3 in., length, 35 ft. 5 in. Speed is given as over 500 m.p.h. The photograph at left was taken by the gun camera of an AAF fighter as it shot down an Me-262 that was attacking U. S. bomber formations. The pilot bails out of the Me-262 by pushing a button which releases catapulting device that throws him clear of the plane.



I Learned About Flying From That!—No. 66

By

WILLIAM S. FISHMAN

Retractable landing gear plus a slushy field and freezing weather caused this crash landing.

LIGHTPLANES and bad flying conditions make a dangerous combination, even when you add a generous portion of flying experience. When the latter ingredient is missing, something is bound to happen. In any event, a slushy field and my own poor judgment add up to my first washout and the sadder and wiser viewpoint from which I write this "little lesson."

It happened in the spring of 1943. I had logged several hours in my Culver, enough to inflate my confidence in the plane's performance—and in my own flying skill—under all sorts of weather conditions. Of course my friends had warned me that the small wheels and light gear of my plane made it unsafe to operate on boggy fields. But I had operated from Ford-Lansing's sod field, at Lansing, Ill., throughout the winter without mishap. Even the alternate freezing and thawing of spring failed to deter me from making flights whenever I was so inclined.

Early in March I decided to make a trip from the Ford-Lansing airport to Aurora, Ill. The weather was just above freezing, and the snow and ice which had covered the field was just beginning to melt into slush. I made a rather wobbly take-off, finding it difficult to pick up proper ground speed through the slush. In order to accelerate the rate of climb, I retracted the landing gear immediately upon becoming air-borne. The flight to Aurora proceeded without further incident, taking about 20 minutes flying time. The Culver operated smoothly and the air was excellent.

Upon sighting the Aurora port I attempted to let down the landing gear—and found that it wouldn't budge. I circled Aurora for almost an hour, trying frantically to release the gear. But it was frozen solid.

When I finally realized that a landing *sans* wheels had to be made, I decided that my home field was the place to do it. On the way home I happened to glance at the label on the fire extinguisher. It pointed out that the extinguisher contained carbon tetrachloride which has anti-freeze properties. Immediately I emptied its contents into the mechanism of the gear. But the only result was a terrific odor, almost suffocating in its effect.

Reaching Ford-Lansing the thought came to me that I ought to notify the ground crew that I was coming in on the belly. I buzzed the field at hangar height three times before the flight operator noticed that my flying was erratic. Later the boys told me that they thought that I was simply having a bit of fun. Finally, by flying about five feet off the ground and pointing toward my retracted gear, I made my predicament clear. A station wagon was sent out to make a landing circle in the soft snow about midway up the field. The flight operator got a physician on the phone, asking him to hold on until it was determined whether the landing would result in injury.

Meanwhile an instructor had taken off in a Taylorcraft in the attempt to signal me that I should cut the switch before landing. The Culver, however, has an automatic throttle stop which prevents reduction of engine speed below 1,800 r.p.m. while the wheels are retracted. Consequently I could not reduce my speed enough to allow him to approach. Without a radio, I could not determine what he wanted to tell me.

Only lack of experience kept me from realizing that had I mushed my plane I could have reduced its speed to that of the Taylorcraft. But if the controlled speed of my plane prevented the instructor from getting his warning to me, it also made the warning unnecessary. The throttle-locked speed made a normal glide pattern impossible. A dead-stick landing was the only alternative.

I made a low power approach, cut the switch cross-wind and came in at a normal landing angle. The tail wheel sat down and the plane assumed a normal landing attitude except that there were no wheels to support the forward fuselage. I held it up as long as the elevators held on, but finally they let go and the plane went down on its belly. The prop was stopped vertically and splintered. Otherwise the landing was quite smooth.

I admit that my washout was my own fault. The reason for the jammed gear was that I had thoughtlessly retracted the wheels immediately after take-off from a sloppy field. The mud and snow which had not been allowed to drain off the gear was packed tightly into the wells between the wheels and the fuselage. At flying speed and lower temperature the whole business had frozen solid. END

William Fishman's Culver Cadet after landing sans wheels. Slush picked up by the wheels on take-off froze them solidly in the retracted position, making the belly landing necessary.

Here's my postwar business!

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Letters

FLIGHT ENGINEER FUTURES

Sirs:

Many of us who have had several months training as flight engineers on multiple-engined aircraft are wondering if the experience we have gained will be put to use in post-war aviation.

What, in your opinion, will the future hold for men with such training?

E. W. THOMPSON, AMM3/c
Pacific Theater

● See the article "Do Flight Engineers Have a Future" on page 56 of this issue. —ED.

FORTRESS FAUX PAS

Sirs:

We wish to take issue with you for incorrect credit given in your December, 1944, issue of FLYING. We refer to the *Flying Fortress* shown landing with a parachute unfurled from the tail gunner's compartment to aid in landing after brakes, electrical system and instruments had been shot out on a bombing mission. You stated this plane was landing in England.

The bomber in question was attached to the U. S. Fifteenth Air Force [in Italy] which has yet to have a bomber land on a field in England. Its identity was ascertained by checking the group symbol on the tail, the squadron identification symbol and the aircraft serial number. The pilot on this particular mission was Captain Twamley who has since returned to the United States.

S/SGT. C. J. BEAVER;
SGTS. R. C. BILLMAIER, V. P. BLATT, M. E. VEALE AND CPL. G. L. SMITH
European Theater

LICENSE THE "L" PILOT

Sirs:

A recent amendment to CAR, Part 20.129, provides for CAA pilot license issuance to all military pilots who have been on solo flying status for six months and who possess the necessary aeronautical experience to qualify. But when liaison pilots attempted to obtain their commercial licenses, they found that all they could get was a private pilot's license. We are now informed by the senior aeronautical inspector, Meacham Field, Fort Worth, Tex., that only "regular Army Air Force pilots" are eligible for such commercial licenses.

The article entitled "The Sergeant Flies His Jeep" in the January issue of FLYING points out that "L" pilots are really pilot-mechanics. The majority of us have served as such for at least a year. We not only fly planes powered with engines from 65 to 290 h.p., we also repair them. We are expert navigators, capable of hitting our ETA on a 200-mile or more cross-country flight and we believe our flight ability will rate along with that of the best qualified military pilots insofar as requirements for a commercial certificate are concerned.

Do we rate that commercial along with other military pilots or not? If not, why?

S/SGT. H. K. COOK
Brownwood, Tex.

● CAA says that the more extensive training of regular AAF pilots gives them the edge. "L" pilots must pass the complete written exam and flight tests to obtain a commercial license. But that should be easy for the experienced "L" pilot.—ED.

Sirs:

Maybe some of your readers would be interested in our newspaper the *G. I. "L" Pilot*, published for liaison pilots wherever they may be.

We, in turn, are interested in any information about liaison pilots or copy along this line that you may have.

We are writing to FLYING because we believe it is the leading publication in its field.

S/SGT. P. W. DARLING, Editor
G. I. "L" Pilot
Brownwood, Tex.

● See "The Sergeant Flies His Jeep" in the January, 1945, issue and "The Maytag Messerschmitts" in the March, 1945, issue.—ED.

LIKES THE CUTAWAY

Sirs:

Your cutaway of the Republic *Thunderbolt* (February issue) and the accompanying article were excellent. Inclusion of this regular feature is a decided step forward in FLYING.

In some future issue how about one of the Focke-Wulf Fw-190 or the *Spitfire*?

JOSEPH KOHLMAN
Baltimore, Md.

● We will present foreign planes as opportunity permits. For the present, we're pretty busy with American types.—ED.

MR. WHITING TAKES A BOW

Sirs:

"Shakedown Cruise" in February FLYING is highly commendable. Although a civilian, I am proud to have come in contact with the men, aircraft and plane described in the article.

John R. Whiting's excellent writing ability plus the fine, dramatic composition of his photos make an excellent feature. Articles like this one make FLYING an outstanding monthly.

WILLIAM NOONAN
San Diego, Calif.

LET'S GET IT STRAIGHT

Sirs:

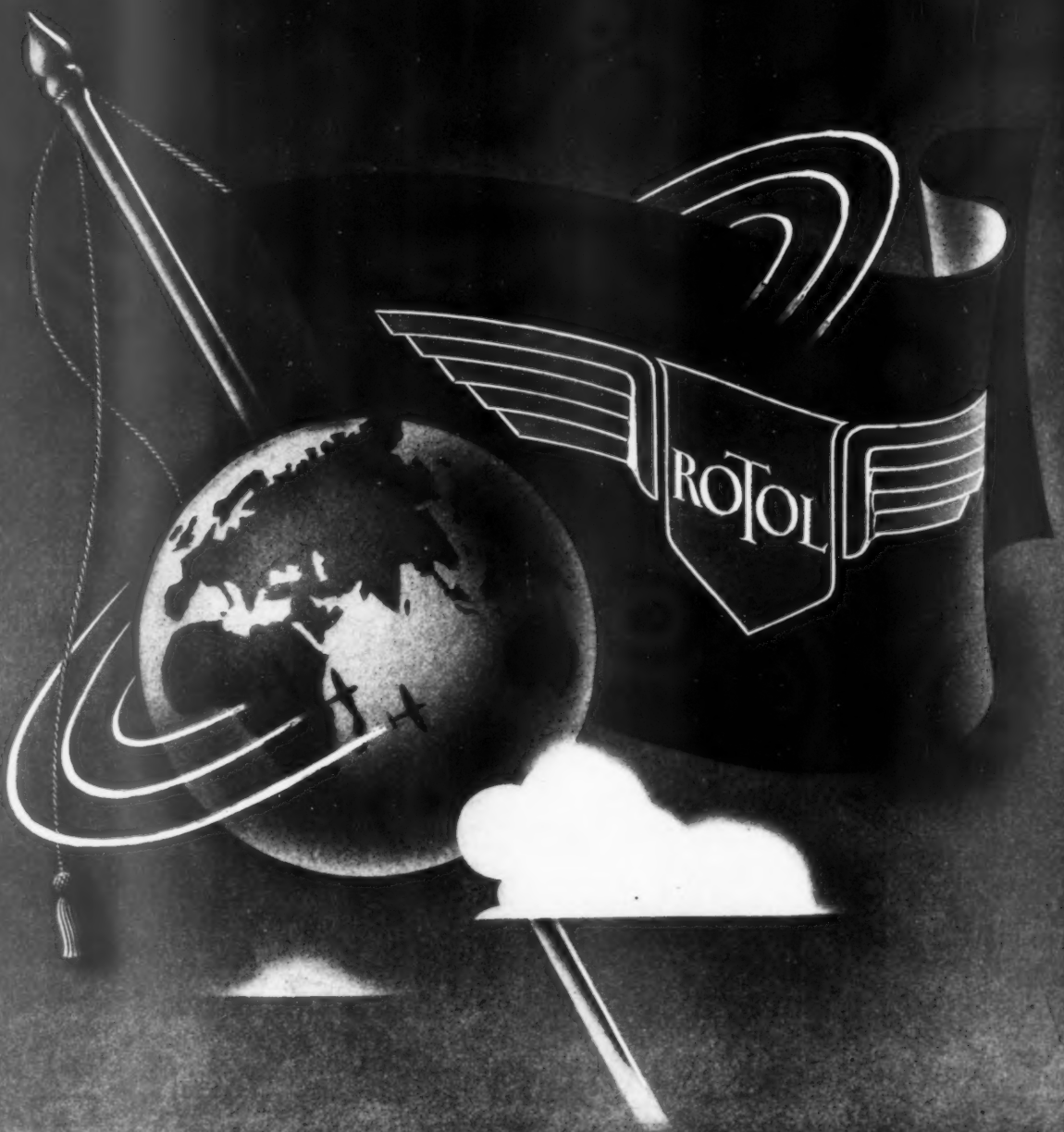
I believe T. B. Bush has the wrong slant on airline vs. military flying. (See February, 1945, Letters.) We airline men do not claim to be the best pilots in the world; we certainly know that the Army has excellent pilots. Flight Officer Bush comments on our two-engined aircraft

(*Continued on page 154*)

FLYING

"Last one down is a stinker!"

PERFORMANCE AND RELIABILITY



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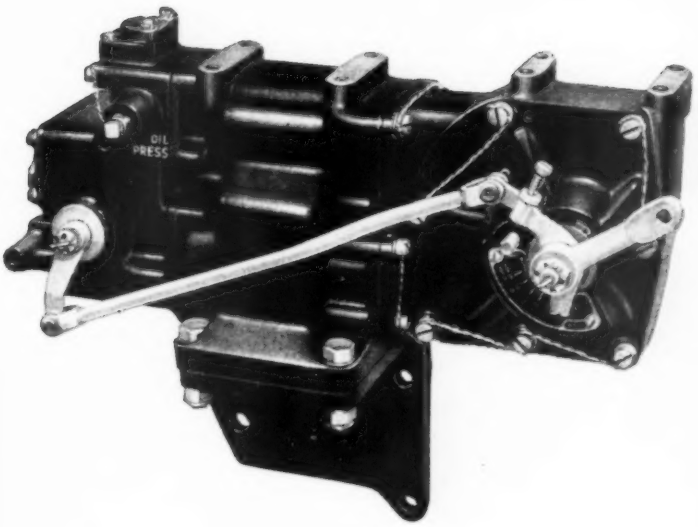

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THE LIBRARY

FLIGHT TO EVERYWHERE, by Ivan Dmitri; published by Whittlesey House-McGraw-Hill, 330 West 42nd Street, New York. 240 pages, 450 photographs (50 in color). $6.00.

Thirty-two thousand miles of the Air Transport Command routes are recorded in this impressive picture book by Ivan Dmitri—the man whose color photographs for American Airlines and Consolidated Aircraft Company have been outstanding for many years. With the sponsorship of Maj. Gen. Harold L. George, commanding general of the ATC, Dmitri flew to Natal, then to Accra on the Gold Coast of Africa, across the Dark Continent to Khartoum, around the tip of Arabia to Karachi, over India and across the Hump to Kumming, China. His return flight crossed Asia to Cairo, followed the route of Rommel's retreat to Tunis, hopped over to Palermo, and on the way home included spots such as Prestwick, Scotland, and Reykjavik, Iceland.

This is not a combat story but an impressive dramatic record of the Army Air Forces mammoth freight and passenger system. It is as much a look at all the stops en route as it is an examination of the technical side of the Air Transport Command. Yet nowhere else has such a complete account of ATC work been told in words and photographs. Conversations with pilots, mechanics, administrative officers, give as much of the book's flavor as the 450 photographs. Plane repairs in sand storms and blizzards, the start of the famous Ploesti raid, the Army Airways communication system and reconnaissance photography are some of the technical highlights of the book.

JOHN R. WHITING
Managing Editor, POPULAR PHOTOGRAPHY

PIONEERING THE HELICOPTER, by C. L. "Les" Morris; published by McGraw-Hill, 330 West 42nd St., New York, in 1945. 161 pages. Price $2.75.

Here is a book rich in argumentative data for both skeptic and avid supporter of the helicopter principle of flight. Much will be found to satisfy curiosity regarding helicopter development—the book is based on experimental flight data of the VS-300, the first truly successful helicopter in this country.

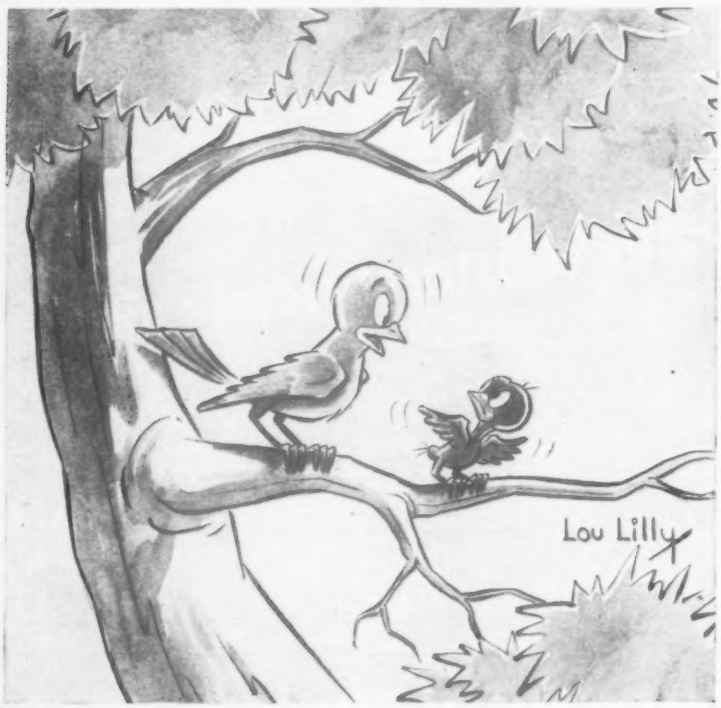
Chief test pilot for Sikorsky Aircraft, "Les" Morris has logged his personal experiences while flight-testing the VS-300 and its offspring XR-4. But the book is as much a page from the life of Igor I. Sikorsky as it is a detailed study of the Sikorsky helicopters.

One chapter is devoted to the principle of rotary-wing flight. Written in a light, non-technical vein, it sketches the basic concept of the helicopter from its birth near the end of the 15th century to the present day machines.

The trying days of VS-300 development are reviewed from the mock-up stage to a machine that today flies straight up or down, hovers in midair or travels sideways, forward and backward. The reader is carried through a maze of experiments to the birth and final perfection of the XR-4 which demonstrates the ability of the helicopter to land in small areas, on the decks of ships ploughing through rough seas or even on the surface of the high seas. The operation of these machines are described in minute detail, but the description is confined to the helicopters developed by Sikorsky Aircraft. Models produced by other manufacturers are left for other writers to present—an omission which may disappoint many readers. It is certain that considerable reading appeal would have been gained had the book included a chapter on all present helicopter models.

Some material will be found in the book that has been used before by writers who evidently obtained their material through contacts with Morris or Sikorsky Aircraft. More disappointing is the author's refusal to commit himself to any predictions. His prophecies are painfully couched on dependent intangibles and he prefers to quote Igor Sikorsky rather than stand alone. However, the many fine photographs and illustrations, together with the author's personal experiences as a test pilot, make the book well worth reading.

HOWARD GRANGER EARL



FLYING

"Remember, Junior, no power dives 'til you grow your flaps."

SHORT VIEWS

YOUNG AMERICA'S AVIATION ANNUAL—1945, by David C. Cooke; published by Robert M. McBride and Company, 116 East 16th St., New York, in 1945. 220 pages.

Using clear, non-technical language, the author of this book has presented an interesting treatment of modern warfare in the sky. Devoting sections to the air power potency of Army Air Forces, Naval Aviation and the aircraft industry, the information it contains will prove interesting to the old as well as the young.

One chapter is devoted entirely to the development and characteristics of the huge Boeing *Superfortress*. The entire book is well illustrated with photographs of all types of aircraft, including those of enemy forces. Its simplicity will be appreciated by those not conversant with military terminology.

AIRCRAFT MECHANICS HANDBOOK, edited by Paul Van Winkle; published by The Manual Arts Press, Peoria, Ill., in 1944. 392 pages. Price $2.75.

An up-to-date, technical reference guide for apprentices, students, mechanics, factory workers and engineers—all those responsible for "putting planes in the air."

AIRLINE GIRL, by Patricia O'Malley; published by Dodd, Mead & Company, 432 Fourth Ave., New York, in 1944. 202 pages. Price $2.

A bit of fiction which serves as a vehicle for the modern young woman's views on aviation.

END

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AIRCRAFT OWNERS AND PILOTS ASSOCIATION

AOPA NEWS

The Aircraft Owners and Pilots Association (AOPA), with National Headquarters Office located in the Carpenters Bldg., Washington 1, D. C., is a non-profit organization composed exclusively of pilots. It looks after the pilot's best interests in all phases of aviation and helps individual pilots with their individual problems. The AOPA operates with a full-time professional staff and is the largest group of civilian pilots in the world. This column is edited by the Aircraft Owners and Pilots Association and opinions contained in it are not necessarily those of FLYING. A special bulletin is sent each month to all registered AOPA pilots and also confidential newsletters from AOPA's Washington staff are sent members from time to time.

WEST COAST PROCLAMATION

On Febuary 10 west coast pilots read in their newspapers a lengthy proclamation (No. 22) issued by the western defense commander regarding their rights and privileges as non-scheduled airmen. In general this was accepted with some disappointment even though it permitted limited student training activities within the Western Vital Air Defense Zone.

It had been hoped that the terms of the proclamation would be more liberal and that a larger area would be opened up to civil flight training than will become available under the new proclamation and its implementing instructions from the western defense commander.

PENALTY CLAUSE. The inclusion of a penalty clause in the proclamation was a surprise to most pilots as it effectively points out to the itinerant non-scheduled pilot that he must behave himself and follow instructions if he wishes to fly within the Western Air Defense Zone. Previously, the authority for restricting and controlling civilian flights within the area had been the subject of considerable debate. The current proclamation removes all doubt—pilots who fly in violation of the proclamation will be subject to action through the Federal courts and face the possibility of exclusion from the West Coast area.

The proclamation does not define the area in which limited student training may be conducted, but states that the defense commander at his discretion might, from time to time, zone the area by dividing it into two categories—areas in which limited student instruction will be permitted and areas in which limited student instruction will be prohibited. Within the free areas, operators may request clearance from the Interdepartmental Air Traffic Control Board, and if their proposed site and local flying area are found to be clear of interference with military activities, requests will be granted.

The point-to-point flying rules remain as heretofore established and such flights may continue to be conducted within both the free areas and the prohibited areas provided they are certified to be in the furtherance of the war effort.

PROSPECT FOR FURTHER RELAXATION. Consensus is that further relaxations will be possible, depending upon the results of the operations under the new ruling. It is clearly a decision which non-scheduled pilots can make or break. If flights under the new proclamation are conducted with reasonable care, further relaxations are believed quite imminent. On the other hand, an abnormal number of violations will undoubtedly prejudice the cause to the extent that further liberalization will not be possible. The regulations may even be tightened up, depending upon the number and seriousness of the violations.

NEW SCALE MAPS

It is reported that the Coast and Geodetic Survey is giving considerable thought to the problem of aeronautical charts. At the present time, in addition to the radio facility charts, there are two standard aeronautical charts published by this agency for air navigation. These are the *regional* aeronautical charts, sometimes known as the "M Series," and the *sectional* charts. There are a total of 17 regional charts covering the U. S. and a total of 87 sectional aeronautical charts of larger scale covering the country.

For pilots who fly faster aircraft and who depend primarily on radio aids, the regional chart has been found adequate, and preferable, to the sectional aeronautical chart which is designed primarily for contact flight where the pilot requires terrain details as check points rather than radio fixes.

It is now proposed to reduce the number of sectional charts by printing them on a larger piece of paper, although retaining the same map scale. In this manner the total number of regional charts will be increased from 17 to 39 by covering a smaller area per chart.

AOPA MEMBERS IN SERVICE

AOPA's honor roll of members serving in the armed forces now totals approximately 1,700 names. AOPA officials are convinced, however, that this is only a small portion of the total number of AOPA members actually serving with the armed forces. An appeal is herewith made for members and their friends to advise AOPO of the names of all AOPA pilots serving their country. Advice should include the branch of the service to which they are attached.

Serious study is also being given to strip or route maps. Route maps are actually a combination of strip maps bound into a convenient size booklet. By turning pages of the booklet consecutively, the area over which the flight will proceed can be followed with a "safety margin" of approximately 50 miles to either side of the proposed course included on the maps. The Coast and Geodetic Survey sometime ago completed an experimental book showing the route from San Diego to New York. Considerable thought is also being given to the desirability of including airport information on the backs of aeronautical charts.

The opinions of AOPA members will be very helpful and AOPA pilots are requested to send their suggestions to AOPA National Headquarters, 1003 K St., N. W., Washington 1, D. C.

PILOTS TO GET NAVIGATION DATA

AOPA has for many months been endeavoring to convince military authorities that certificated airmen should be entitled to receive copies of the *Army-Navy Airport Directory* (which includes a complete listing of civilian airports), the Army-Navy edition of *Weekly Notices to Airmen, Radio Aids to Air Navigation,* and other aeronautical publications and aeronautical charts.

Two months ago AOPA announced to its members that sectional and regional aeronautical charts would henceforth be available to all licensed airmen. We are pleased to announce that this policy has been extended to include the much needed sister publications.

It is now possible for any certificated airman to obtain "restricted" documents pertaining to airway and airport facilities. The classification of the CAA publication, *Radio Aids to Air Navigation,* will be reduced from restricted to unclassified in the very near future. The *Airport Directory* and *Weekly Notices to Airmen* (Army and Navy edition), although retaining their restricted classification, will be made available to non-scheduled airmen.

The CAA has advised AOPA that it will discontinue publication of the civilian issues of *Weekly Notices to Airmen* and *Airport Directory* and henceforth make available to non-scheduled pilots the Army-Navy editions. It is understood that, under the new ruling, non-Government agencies may resume publication of airport directories and other publications relating to airway aids and facilities.

AIR MARKING PROGRAM

As recently reported to AOPA members, it is now possible to mark towns, villages, and other points for air travellers except for the region 150 miles from the west coast where the air-marker ban is still in effect.

The CAA has published a manual to assist interested parties in erecting these aerial signposts—copies may be obtained by members from the AOPA office or directly from CAA. AOPA has also published some leaflets which may be dropped from the air by pilots (after CAA waivers have been obtained for such purpose). END

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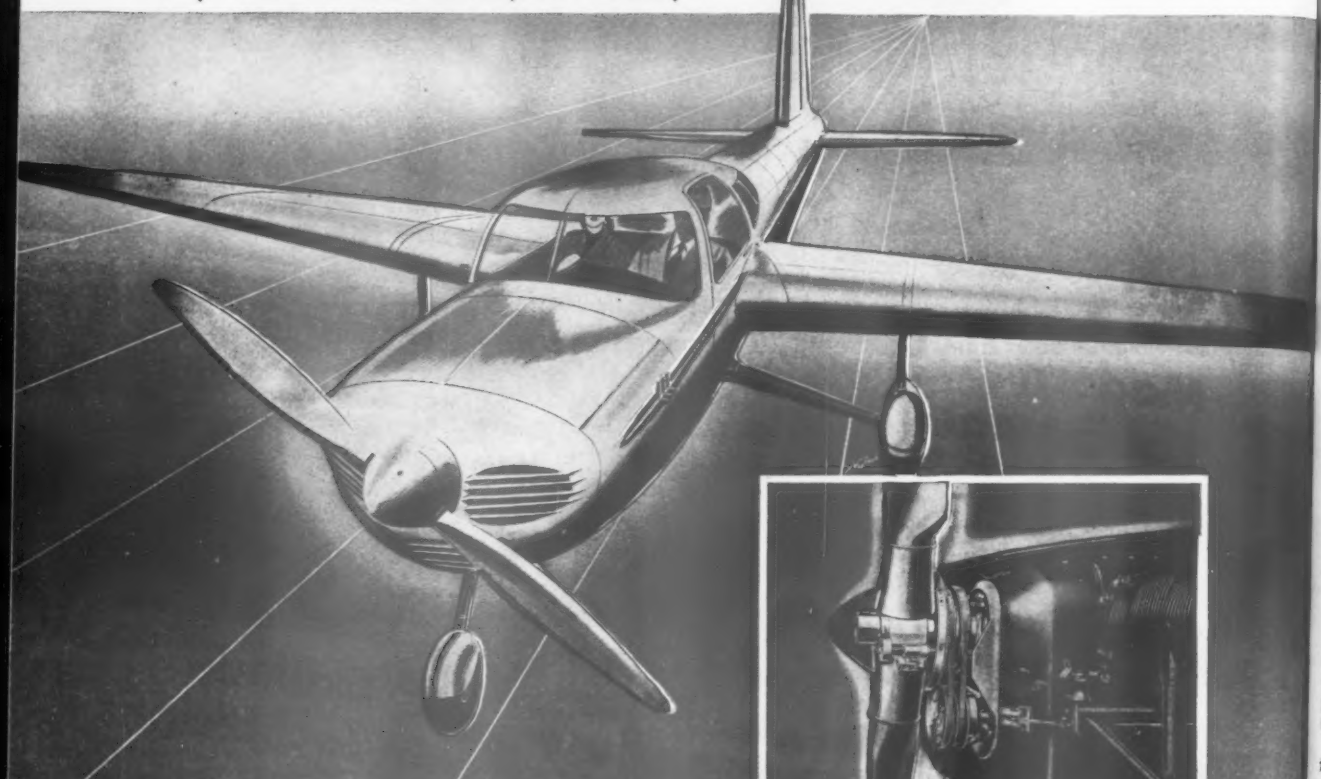

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How the AAF Uses Air Power

(*Continued from page* 23)

all the steel production in Germany would not have been economical in lives or planes, or in terms of results: the Nazis had a great backlog of steel due to their excess production capacity over military needs. Also, there is too great a time lag between a raw product such as steel and the finished planes, tanks and guns. Weak spots in the military economy had to be found—factories where production of a vital piece of war materiel was highly concentrated and which moreover was *close in time* to the front. The aid of experts throughout the United Nations has been enlisted in choosing targets with these qualifications. Among the most important have proved to be ball-bearing plants, fighter assembly plants and engine assembly plants, in addition, of course, to fuel production and storage centers. Results of the planned strategic air war on such centers became apparent in decreased overall war production and in decreased enemy air power, which in time resulted in greater and greater Allied air superiority and more effective and economical strategic missions. The great objective of the strategic air war—paralysis of the enemy's ability to wage war—had been achieved in a gratifying degree by the advent of D-Day in Europe.

Now let us go back to the enemy's second step toward an offensive: movement of his forces. Here is where tactical air power, as it were, takes the ball from strategic air power.

The mission of tactical air power is threefold:

1. To establish and maintain local air superiority.
2. To prevent movement of supplies and troops to the front; in other words, *isolation of the battlefield.*
3. To participate in a joint effort with ground forces in the immediate battle area.

The second of these missions is self-explanatory and has been demonstrated again and again in all theaters of war but most clearly, perhaps, in the battle of Europe—the destruction of railroads, rail marshalling yards, supply dumps, bridges, highways, truck convoys, troop concentrations, repair and service units, docks, shipping, and everything that makes an army mobile. An enemy's ability to fight depends on its ability to move and supply itself: Destroy this ability and you have greatly limited the offensive possibilities.

The first mission perhaps requires a little clarification. The attainment of air superiority in a theater as the *first* objective is necessary because if you have two opposed air forces of equal strength you have the old result of a stalemate. The air force, therefore, is first of all assigned the job of knocking out enemy airdromes, hangars and other installations, planes in the air and planes on the ground. A variety of aerial weapons is employed for this as well as other tactical missions: heavy and medium bombers, fighters or fighter-bombers capable of strafing and even of destroying planes on the ground.

Once air superiority is established it can be maintained with a small number of planes—another reason for making this the first of the three tactical objectives.

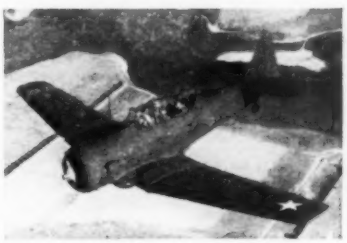
The third mission of tactical air power—to participate in joint effort with the ground forces in the immediate battle area—also has been too well illustrated in the various successful invasions of the Allies to require detailed explanation. Planes cover the advancing ground troops, shielding them from counter air attack. They perform reconnaissance in advance of the wave of invasion; they knock out pillboxes and other concentrated centers of defense; destroy supply and other auxiliary units attached to the front lines; and finally, combine with ground forces to carry forward spearhead groups of glider troops and paratroops.

These three priority missions of tactical air power may overlap and vary, just as tactical and strategic air power combine and overlap in some instances, as, for example, in helping to establish air superiority. But this is the basic pattern.

Let us go back to the hypothetical enemy offensive considered earlier in the article. With his anticipated sources of arms and supplies diminished through strategic attacks, with his lines of communication disrupted, the enemy has two choices: he can either postpone the operation, or carry it through on a more limited scale. Either choice narrows his chances of success. With the next step on the part of the opposing army—neutralization of enemy air power—he loses another prerogative, which is the choice of *time* at which to strike. With supplies and reinforcements cut off by continuing bombardment and strafing, with arms and vehicles rendered unserviceable and without available repair units, the enemy finds the tide of battle turned against him. The final chapter is the follow-through of tactical air power on the heels of the defeated enemy, once again disrupting communications lines and supply installations until what might have been an orderly retreat is turned into a rout.

To sum up: The air force function against strategic targets prepares for the defeat of the enemy by destroying his means and will to fight. The tactical function makes possible the defeat of the enemy by establishing and maintaining air superiority, isolating the battlefield, and participating in joint effort with ground forces in the immediate battle area.

There is certainly no phase in this war that is more American, more intensely interesting or more assured of accomplishing its objective than the strategic air of-

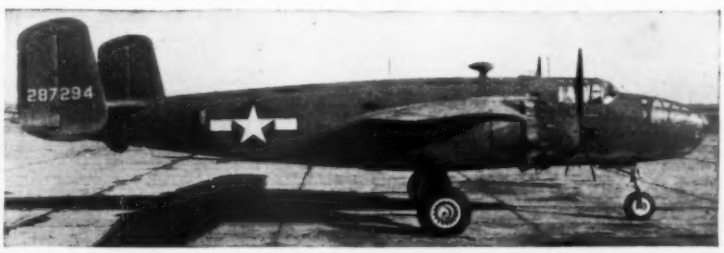


CHANGE TRAINER TYPES

INCREASED availability of *Texan* single-engined advance training planes due to curtailment in pilot training programs has caused revision in AAF flight training technique.

Formerly cadets in pilot training progressed from the 225-h.p. Boeing *Kaydet* primary trainer (above, left) to the 450-h.p. Vultee *Valiant* basic training plane. They then stepped up to the 550-h.p. *Texan* (above, right), with bomber pilots getting twin-engined transition training in *Bobcats, Wichitas* and similar craft.

Under the newer plan, students will go from the *Kaydet* directly to the *Texan*. Bomber pilots will be given training in the TB-25 (below), which is a *Mitchell* bomber stripped down for instruction purposes. The new sequence will eliminate the lighter, slower two-engined transition trainers used in the original training sequence. Training time is reduced with no loss of efficiency.



fensive. The science and conception of picking the vital elements in the industrial, commercial and economic fabric of an enemy on which hostile military strength depends was developed in America, at the Air Corps Tactical School, during the period about seven years before the beginning of the war. At that place, the concept was presented in complete detail to our ground and naval people, and was presented in broad detail to foreign observers. Surely the details of that concept were available to the *Luftwaffe*. Whatever excuse the Germans may present for having lost this war, the reason that they failed to defeat England at the outset was their rejection of the concept of the strategic air offensive.

The isolation of the battlefield can best be illustrated by a brief discussion of Normandy. If you can go back to Civil War days and think of Jeb Stuart sitting on every road and railroad for hundreds of miles leading up to Rommel's and Von Kluge's army, you can imagine the effect of our tactical air operations on the Germans. The enemy was literally starved and strangled to death by tactical air operations.

In the summertime on the continent of Europe we have very few hours of darkness. During the hours of daylight our fighter-bombers, from the instant we set down in France, destroyed all the highways and railroads leading to Rommel's army. With our tactical operations we destroyed the rail and highway bridges across the River Seine. That meant that, except under cover of night and over hastily-constructed pontoon bridges, the enemy could move nothing across that river barrier. We destroyed pontoon bridges across the River Loire. Rommel saw the Allied armies growing in strength, constantly being supplied. He didn't have an air force to interdict our surface vehicles and we kept him from moving up to the front. He saw a greater and greater disparity as days went on between the force the Allies had and his own. Reinforcements arrived at the front in driblets. He lacked that essential of modern warfare: mobility.

If you go across the world to the other side and view the operations of the Pacific war both in the South and Southwest Pacific, you will see that we first struck at air bases, destroying both aircraft that came up to fight us and those on the ground, until we had achieved a supremacy or achieved odds in our favor so the enemy could no longer offer effective resistance to our subsequent amphibious operations. You will remember Bougainville, the attack on Rabaul and others as preliminary to amphibious operations that followed.

In these operations the Navy played a considerable part, once again illustrating that co-ordination of air with land or sea forces is the desideratum in modern warfare.

In MacArthur's set-up in the Southwest Pacific we isolated Cape Gloucester by air for two months. Before our Marines landed at Gloucester only small barges could get in to furnish replacements, food or ammunition. The same thing was true all the way up the coast of New Guinea. You have also a remarkable example of the result of air action in isolating a battlefield and keeping the enemy always at a disadvantage on ammunition and supplies at Leyte.

Gaining air superiority by hitting the enemy in the air, on the ground and at his aircraft factories was an imperative prelude to our invasion of Africa. It made possible the safe conduct of the huge convoy of men and supplies to Africa. It also made possible the miracle of the landing and that more welcome miracle—a low casualty list. It sped the Allied move over to the offensive and, by the same token, sped retreat of the Germans from Africa.

Out of the desert campaign in Africa, as a matter of fact, came the present system of tactical air operations and of land-sea-air co-operation which later was to work so effectively in invading France and going forward with the bitter job of bringing the Nazis to their knees.

During the African Desert Campaign, Brig. Gen. (now Maj. Gen.) Laurence S. Kuter was the American Deputy Commander under British Air Marshal Coningham of the Northwest African Tactical Air Force. This force, composed of both British and American units of fighters and bombers, was therefore the first expression in actual practice of the long months and years of experience gained by the RAF in the only theater in which Allied air units had at that time fought the enemy alongside the ground units in the field.

It was the quintessence of battle experience, the result of many mistakes, many trials and, at last, resounding success. It was something far superior, as results have proved, to anything which the Germans had ever evolved. It was an example on a big scale of the encouraging fact that the Allied commanders were clearly able to utilize the experience gained by hard fighting in this way. It became the pattern of the future, the way in which air participation in co-operation with armies in the field could be employed to beat the enemy and win the war. Changes in the 1-2-3 technique to perfect it were only natural, but the basic conception of a tactical air force in the actual battle area remains the same.

The Army struck from the ground, the tactical air force struck from the air. Harmony was the watchword. In the battle of Mareth, for instance, the first move was to blitz enemy airdromes out of the fight and in the crises of the battle in front of El Hamma, *Hurricane* tank busters led the enemy to break and retreat. At Wadi Akarit, air units in the north and center were concentrated on the German air establishment and once more the Western Desert Air Force was free to work at a maximum intensity on the German forces in the Wadi Akarit

FLYING

"You see, we were rushed last week at Boeing, and I crawled in here to do some wiring."

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Beginning of the End -- of Tokyo

November 23, 1944, a fleet of B-29's lifted itself off the runways of Saipan—first raid of these sky-giants against the Japanese capital . . . a combination of men, machines, and determination that is being, and will be, repeated with increasing size and intensity.

In the spring of 1942, Doolittle's planes averaged 30 seconds over Tokyo. Two and a half years later, the world's mightiest bombers loomed high over the "sacred city", pin-pointed their targets, unloaded tons of bombs, and were away after more than 30 minutes over the city.

This was a light raid — comparatively. Others followed it. Day by day B-29 strength in the Pacific is building up with a slow but steady crescendo. More planes, more bombs, more flights, more destruction.

Boeing has done a masterful job in designing and building these ships . . . as has Wright in the mighty engines that get them there *and back*. And numbered among the thousands of vital parts that go into these great Wright engines are CECO carburetors.

Chandler-Evans is proud of this opportunity to pay tribute to all those men and women who have a part in the success of these superb bombers . . . and is proud that the dependability and quality of its carburetors is such that they have been chosen to do their part, however small, in making it the beginning of the end — for Tokyo.

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position. Again the enemy retreated, this time sooner than was expected.

The same tactics—and the same results—applied on a larger scale when D-Day came on the European front. The invasion, from the point of view of air power, did not begin on D-Day. It began more than two years before, when 12 *Fortresses* of the Eighth Air Force bombed rail yards in Rouen as the initial step toward invasion. The great pattern of strategic bombardment was under way. When the actual time of invasion came, the *Luftwaffe* was so effectively battered, as a result, that it did not figure in the battle of the beachheads. Its gasoline and oil supplies had been cut off by strategic attacks on German refineries. Its flyable planes were outnumbered and its factories for turning out replacements were sorely crippled. Even its supply of flying manpower had been crippled by this same pattern of strategic bombardment, for cutting off supplies of fuel and aircraft had resulted in the serious disruption of the *Luftwaffe's* flying training program.

The final results of this two-fold air plan were apparent when the fighting began, not only in depleted enemy airpower but in lack of opposition on land. Both were directly traceable to air blows at the enemy's heartland carried out by strategic forces, supplemented and complemented by tactical airpower's methodically-planned operations in the period preceding D-Day, which helping establish air superiority, disrupted communications, isolated the battle area, and finally moved in with the attacking ground forces to cover their advance.

How air power worked as a team with ground power is graphically illustrated by the lack of tank opposition on D-Day, which turned out to be particularly weak. Why? Because tank factories in Germany had been repeatedly bombed out of the battle of production as a part of the overall strategic plan, while tanks coming to the front had been subjected to blistering attacks from the air by tactical forces, and tank supplies failed to move with the proper rapidity behind German lines because of the aerial destruction of communications systems. This situation applied to all departments in the ground operations. German artillerymen were without the necessary shells. Infantry went hungry and suffered from a progressively acute ammunition shortage. These supplies, comparatively easy to eliminate behind the lines by bombing, would have been liquidated only after costly casualties if they had reached the fighting Nazis on the front.

In modern warfare the axiom that the battle is the payoff still holds true, and one had only to view the battlefront from the air during the battle of the beachheads and of France to see the payoff on the logic of the AAF. "Without air preparation, the invasion of Europe would have been impossible," said General Eisenhower. As contrasted with the hub-to-hub activity of supply trucks behind the Allied lines, Nazi transport was at a standstill except after dark. German marshalling yards, bridges, roads and communications generally were in a chaotic condition.

U. S., British and Canadian transports, carrying reserves and supplies, filled the English channel from shore to shore and moved up front at will, comparatively unmolested. So effective was the one-two-three priority of our air cover that it took longer for German reserves to move from Holland to the front than it would have taken ours to move from Hoboken to Le Havre. Indeed, 20 days were required to bring German reserves from Holland and the last half of the trip was made afoot. When these troops met ours they were worn out from walking, their supply lines and communications were in wretched condition, their morale was near collapse.

The logistics of the winter front in Germany were equally advantageous to our personnel. The now-famous "Red Ball Express" was organized to roll a steady stream of supplies and replacements to our armies even before the front was established. Transport and communications behind the German lines were subjected to the same pasting their equipment got in France before they were forced to retreat. The situation in Germany differed from the situation behind the Nazi lines in Normandy only in that, when the German front was established, we were able to go to work on the heart of the Fatherland.

It is equally pertinent to look at the other side of the coin. We would not have been able to build harbors and roads and establish communications across war-torn France with the speed we did if effective German air opposition had developed. But it could not develop because the first priority of the air had been put first—the *Luftwaffe* had been knocked from the air. It was therefore comparatively easy to take care of Priorities 2 and 3—keeping as many of the Nazis as possible from the battlefront, co-operating with the ground forces in driving the others back, doing the job with the least possible casualties.

On the battlefield proper, another fact is painfully evident. German casualties have reached an appalling total of more than 6,000,000. Ruthless generalship has marked their operations. The same generalship by any one of our leaders would result in his immediate removal from command. We of the democracies neither discount the value of human life nor feel that such a policy wins wars. With air coverage and expert co-ordination on the part of all services, our losses have been kept at an absolute minimum. The first month of our invasion of France resulted in casualties fewer in number than those in the first bloody day of the Battle of the Somme in 1916.

And what of the Pacific? Yet again, the facts speak for themselves. We have gone forward with an accelerating speed as the co-operation of the land-sea-air forces has been perfected and the air priority system applied. Six months were required to take Buna. At the speed that we were moving on the ground it would have taken years to liberate New Guinea. Then the Fifth Air Force went to work on Jap communications, first by establishing air superiority, as was done in the Battle of the Bismarck Sea where, not incidentally, we knocked out one Jap division and all its equipment with an AAF loss of only 12 men.

The one-two-three has proceeded northward at an accelerated pace. A Jap who has dug himself into a foxhole often takes days to pry loose; a Jap caught with thousands of his fellows in a transport is like a duck on a rock. The logic of this—in attack, advance, minimal casualties and ultimate victory—has been as unchallenged in the Pacific as has the fact that our advances have been remorselessly steady.

When victory comes, we of the Air Forces will be the first to hail it as a co-operative effort involving our land-sea-air forces, each of which, aided by air coverage, goes into battle with more and better equipment, less danger of casualties, and more assurance of victory than any other fighting force in the world. END

the British Say...

THE following data are quoted for the North American *Mustang I:* the Allison V-1710-39-F3R engine develops 1,150 h.p. at 3,000 r.p.m. for take-off, 1,000 h.p. at 2,600 r.p.m. at 10,800 feet. Top speed at 13,000 feet is 370 m.p.h., landing speed 90-100 m.p.h. . . .

This information is given for the Republic *Thunderbolt:* using water injection, the 2,000-h.p. Pratt & Whitney engine delivers 2,300 h.p. at 58 inches of mercury. A 30-gallon water tank is carried just behind the engine. Top speed is 375 m.p.h., cruising speed 250 m.p.h. at 2,200 r.p.m. Landing speed is 110-130 m.p.h. Take-off speed is 120 m.p.h. and initial rate of climb is 2,700 r.p.m. Critical altitude is 27,000 feet, but one has been climbed to 43,000 feet. One *Thunderbolt* climbed from the ground to 30,000 feet in 12 minutes. The pilot has 100 pounds of armor behind him and 30 pounds in front; the bulletproof windshield is 1¾ inches thick. Engine changes are made every 200 hours. . . .

These facts are given for the Northrop *Black Widow* (P-61A): the two 2,000-h.p. Pratt & Whitney engines are fitted with water injection. Gross weight is 26,000 pounds. Span is 67 feet, length, 48 feet. Stalling speed is 90 m.p.h., although a P-61 has been flown at 74 m.p.h. with wheels down without stalling. . . .

—AERONAUTICS

A Boeing *Flying Fortress* bearing German service markings recently made a forced landing at Valencia, Spain. The Luftwaffe crew of nine was interned. . . . Two McDonnell XP-67 twin-engined fighters were ordered by the AAF, but only one was completed and it crashed. . . . A German radio report said Boeing *Superfortresses* (B-29) are being brought to Europe by the AAF for use against Germany. The same report said the bomb load of the B-29 is 22,000 pounds. . . .

—THE AEROPLANE

Latest development of the Grumman *Wildcat* to go into service with the U. S. Navy and Fleet Air Arm has been named the *Bearcat*. . . .

THE AEROPLANE SPOTTER

What's a Sperry TR doing up here?

● Photos from a movie of actual operations at an AAF bomber base in England.

THAT FELLOW in the uniform up on the bomber is one of the many Sperry Service Engineers on duty overseas—Technical Representatives with the Armed Forces.

These men know their gyroscopes! They help keep Sperry equipment, gyroscopic and otherwise, at the peak of condition . . . often make check flights in the lead plane before bombing missions . . . perform hundreds of vital tasks in support of combat units.

Here at home scores of other Sperry Service Engineers work at top speed to help keep the equipment flying—and their tasks are no less vital. *In all, some 135 Sperry Service Engineers devote their full time to aeronautics.*

Sperry has always taken pride in its complete *follow-through* service for Sperry devices. The Service Engineers who see that no Sperry product ever becomes an "orphan" are highly trained technical men. *After* the war, they'll be busy following through on the instruments which we will produce for peacetime aviation . . . busy in all corners of the world.

THEY WILL BE responsible for proper installation of Sperry equipment . . . for instructing in proper operation and maintenance . . . for servicing, should trouble occur. And for keeping our Research Laboratories informed about the performance of equipment in the field, thus helping to make Sperry devices ever finer.

SPERRY GYROSCOPE COMPANY, INC. GREAT NECK, N. Y.

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★

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Blueprint for a State Air Department

(*Continued from page 30*)

operation of the civil airways. Just prior to the war the domestic airlines were operating 352 aircraft over some 33,000 miles of civil airways. At the same time, about 25,000 other civil aircraft were in operation in the United States, some of them using the airways part of the time but, for the most part, they were flying off, rather than on, the civil airways.

How many employees would have been required in the CAA to give the same service to these 25,000 aircraft? How many employees would be required if the number of non-scheduled aircraft were to increase to the predicted half-million total?

We must consider still another problem. Civil aviation has been developed largely through the assistance of direct and indirect Federal subsidies. It has thrived when the pipeline to public funds was open and wilted immediately with the closing of the faucet. Can aviation develop its own natural markets for its merchandise and services, or is it an industry which can survive only to the extent that Congress is willing to ladle out funds from the public treasury?

If we must admit the latter case to be true, then Congress is dealing with a social and economic rather than a technical problem, and the obligations and duties of the states must be viewed in one light; but if aviation is to be self-sustaining, the respective duties and obligations of the Federal Government and the several states must be examined in quite a different light.

Under the first situation, what are the duties and obligations of the state in the public interest? They are far more numerous and far more complex than can now be realized and they go far beyond those functions now performed by the Civil Aeronautics Administration.

The pending Federal-aid airport bills in Congress attempt to meet some of these problems by attaching contractual obligations on the airport sponsor to obtain the approval of airport projects. As a mammoth public works program, these bills leave little to be desired. As the framework for a sound and healthy aviation industry, they are fantastic in the gap which will remain between the completed airports and their utility. Here the municipality and the state air department enter.

The airport is not like the highway, which runs from here to there. The airport goes nowhere. Its only function, so far as the airplane is concerned, is to assist it to land and take off. Attached to the airport are a number of secondary activities which transform it into a vital connecting link between surface and airborne transportation.

If planning, building and administration stop at the end of the runway, not only on the ground but in the air space above, it will make little difference how many airports we build, how they are built, or how many millions of dollars are expended from the public treasury. This is not a job for the CAA alone or any single public agency. It is a job for the state department of aeronautics, working with the municipality on the one hand, the CAA on the other, and enlisting the cooperation of public groups and industry.

The state department of aeronautics must concern itself with the problems of economy, utility, safety, maintenance, and operation of all airports built for public use. It must be concerned with the problems of surface transportation, flight patterns and zoning. It must exercise licensing powers to protect the public interest in the airport and the public safety. It must solve the difficult problems of relationship between public and private airports, segregation as to kinds of uses, and traffic, separation, and frequency. It must, because the aircraft makes gluttonous use of land in congested areas, work closely with city and county planning commissions.

All of these matters fall within the special police powers of the state and the municipality and cannot be solved by expanding further the provisions of the commerce clause.

It is more than likely that any such airport system as we are now planning will result in a tragic blunder without careful planning of the municipal, state, Federal type rather than by a single Governmental agency. The 6,000-airport plan would provide this country with an airport for every four civilian aircraft in existence prior to the war, or one for every 16 civilian pilots. When this country embarked on its highway building program, nearly 10,000,000 cars were dammed up in cities and towns waiting only for the connecting links between cities. There is no comparable pressure of aircraft which will insure busy airports.

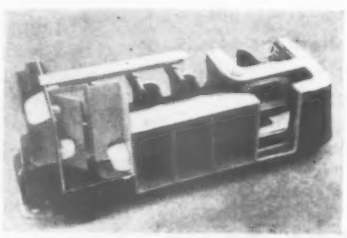
Here again, in sharp relief, we find the duty and obligation of the state to help the aircraft find its natural market and to merchandise its many kinds of service.

What responsibility, if any, has the state in connection with the pilot? It is commonly thought that the CAA now issues licenses to pilots, but it does not. The CAA merely issues a certificate of competency, to which it adds ratings, but the CAA does not license. This service, performed at the Federal level, is excellent,

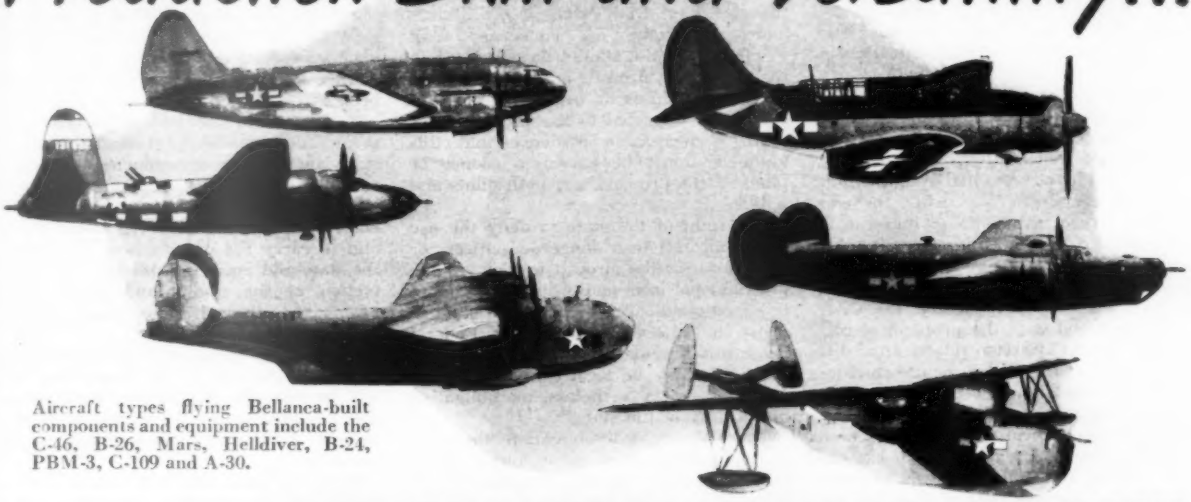
MOBILE AIRLINE STATION

AN all-purpose vehicle designed by Oliver L. Parks, president of Parks Air transport, is suggested as a combination bus-airport-station for smaller cities using feeder airlines.

This hybrid bus and airport station would deliver passengers to and from an airfield and serve as the airport station itself. Cutaway (right) shows ticket counter, compartments for express and cargo, seats for eight passengers and a lavatory. The driver would also be a licensed radio operator, capable of keeping in touch with the in-bound airplane by means of a built-in radio-phone system. He would handle the mail and express exchange when alongside the plane. The bus would drive alongside the plane and eliminate taxiing.



Production Skill and Versatility...



Aircraft types flying Bellanca-built components and equipment include the C-46, B-26, Mars, Helldiver, B-24, PBM-3, C-109 and A-30.

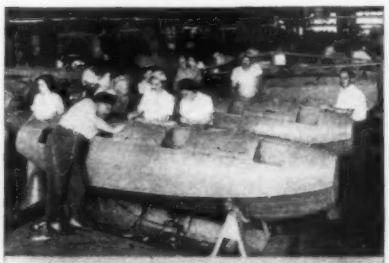
THE KEYNOTE OF BELLANCA WAR WORK

Long before Pearl Harbor, Bellanca began building United Nations aero-armament. Since then many thousands of aircraft components, in great variety, have been delivered to the Army Air Forces and the United States Navy. The manufacturing skill of the Bellanca organization is "on the record" of Bellanca performance. Approval of the company's inspection system has been awarded to Bellanca in the AAF's "Approved Quality Control Rating." War work at the Bellanca plants has topped a quarter-century of Bellanca leadership in American aviation.

BUY WAR BONDS

Quality control at the Bellanca plants is complete and scientific.

Bellanca-built C-109 Tanks deliver gas over the Hump for B-29s in China.

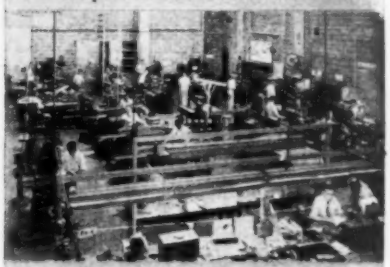


Floats for Navy planes are designed, engineered and built by Bellanca.

Tens of thousands of Martin Gun Turrets are precision-machined at Bellanca.

Flaps and ailerons for wartime planes prove Bellanca production efficiency.

The Sheet Metal Department fabricates many parts, including C-46 cowling.



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BELLANCA AIRCRAFT CORPORATION

NEW CASTLE, DELAWARE

particularly when it applies to pilots who are carrying passengers for hire. The states can add nothing to this function.

In the same manner that the old pilots resented the intrusion of the Federal Government into their affairs, so do pilots generally resent and fear the intrusion of the state governments into their affairs. Regardless of the nature of pending Federal legislation, this becomes another field where the state must eventually assume an obligation and a duty.

Prior to the war we had roughly four pilots for every aircraft. After the war we may expect this ratio to increase to eight or 10 pilots for every aircraft. Assuming that Charles Stanton's prediction of 500,000 aircraft comes true, and that the ratio should be 10 to one, the CAA would be faced with the problem of certifying about 5,000,000 pilots annually. The Bureau of the Budget would shudder at the appropriation required to provide the CAA with the number of flight inspectors and medical examiners required to administer such a task. What is more likely is that the states will eventually be required to assume part of this burden, perhaps that of "licensing" the non-commercial pilots. By whatever means it is done a decentralization of this responsibility will become an absolute necessity.

The states face an immediate problem which is in no sense a duplication of the present activities of CAA. The state is not presently concerned with the ability of the pilot since the CAA adequately takes care of that detail, but the state and municipality are concerned with whether the pilot should be permitted to fly or use an aircraft, and the purposes for which he uses it. Again the old timers can be expected to rise in wrath, but there is increasing evidence that this authority must be exercised sooner or later for the protection of both pilots and public.

The right of the state to deny the use of the aircraft to a dangerous citizen, or one who uses the aircraft to violate state or municipal laws and ordinances, cannot be questioned. The right of the state to insist that the pilot conform to Federal laws and regulations certainly exists, even if it may be legally difficult to enforce. It is, nevertheless, an obligation and a duty of the state.

To carry out this obligation, the state must identify every pilot, either by a form of licensing or by a registration of the pilot's Federal certificate. In the exercise of this function the state naturally would not be permitted to so act as to interefere with the normal flow of interstate commerce. Further, if the right kind of intergovernmental co-operation is achieved, the state function will be carried out in such a way as not to add more confusing red tape to the present burdens of the pilot. For example, this registration could be achieved at the same time the pilot takes his annual medical examination.

Once this registration or licensing has been accomplished at the state level, the duty rests with the state department of aeronautics, working through existing state law enforcement agencies and in co-operation with the inspection and regulatory staff of the CAA, to assist in the enforcement of the Civil Air Regulations and to carry the enforcement further at the state and municipal level for the protection of the public and pilots alike against the criminal, the careless, and the negligent.

The state's obligation to pilots extends beyond regulation. One important aid will be through emphasis on safety from the educational side, working in co-operation with state and national safety councils.

Much the same kind of problem applies to the aircraft as to the pilot. The states will have few worries over those aircraft which "cross state lines in a matter of minutes." That phase of the aircraft problem seems reasonably well taken care of. Here again the CAA does not license but issues certificates of airworthiness. But what will happen if and when we have those additional half million aircraft? Will the Bureau of the Budget be able to provide the necessary number of inspectors?

The state must assume that a portion of this job will be its obligation—and again the state has the duty to know the purposes for which an aircraft is being used and to exercise its police powers to prevent the use of aircraft for criminal purposes or in violation of state laws. Again a licensing or registration will be required by the states, and again it should be carried out in a way which will not be a burden and a nuisance on the pilot and owner.

Again the old timers will express their wrath at this needless intrusion by the states into a field which at first glance appears to be adequately covered by the CAA. It is perfectly true that the CAA is doing an excellent job of insuring that all civil aircraft shall be airworthy, but there is a further problem. It is pertinent to recall that a few days after Pearl Harbor frantic efforts were made to locate and ground every civil aircraft. Some months later, after the Civil Air Patrol had been organized, one of its urgent missions was a search to discover missing aircraft, the whereabouts of which were still unknown. At that time there were approximately 25,000 civil aircraft. How will the CAA keep tabs on half a million?

Public safety and public interest requires that the location and use of aircraft be known and be a matter of record. The light aircraft will find its way into farmer's fields, ranches, and thousands of remote areas and waters. State and local law enforcement agencies must undertake the job of constantly checking up. It is a task which can best be done at the state

WATER TERMINALS

GLENN L. MARTIN has proposed U-shaped tugs to handle flying boats in post-war water terminals. The aircraft hulls would fit into the tugs to be towed to floating tidal docks for further servicing, loading and unloading.

For ports of high-density traffic, Mr. Martin proposes a circular island type of terminal with inclined loading ramps or slips spaced to handle six or seven planes simultaneously. Floating docks would have a single pier leading to the shore while the more expensive island-type terminal would be land-connected by a tunnel.

How to Qualify for a Top-Notch Position in Aviation as a

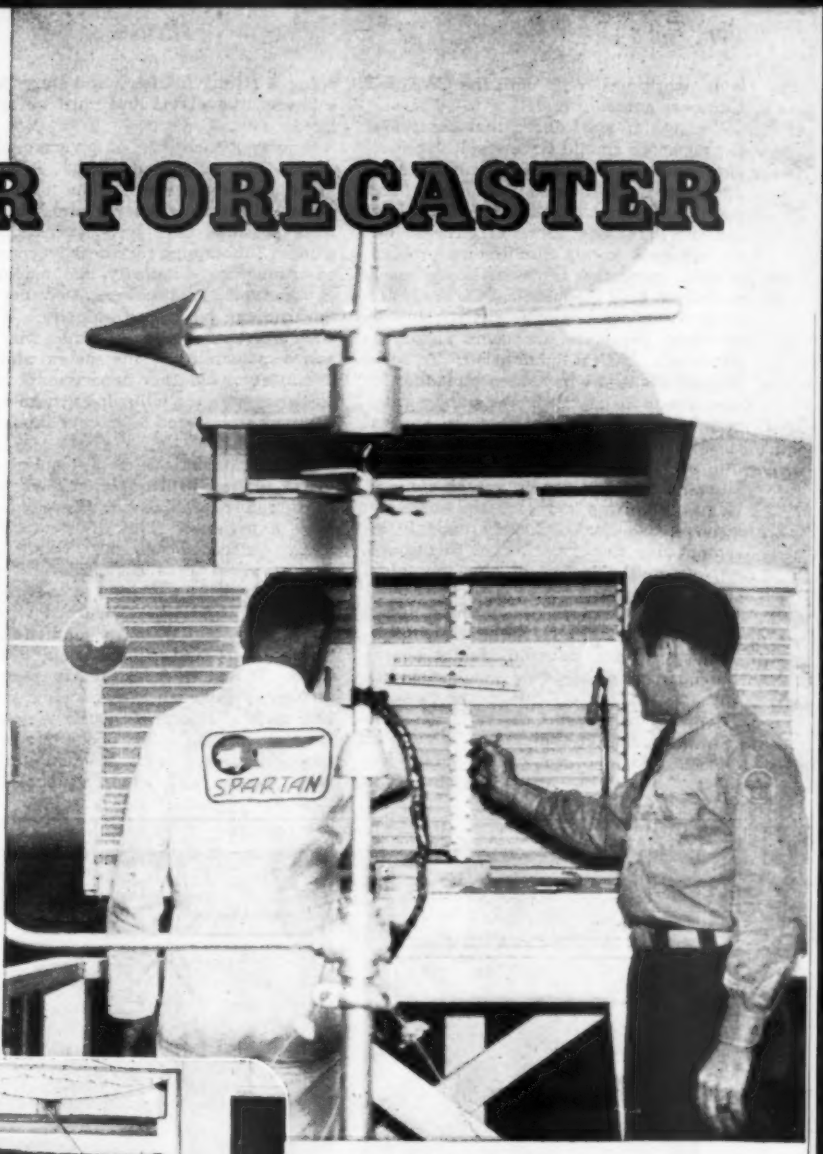
WEATHER FORECASTER

Your training must include practical experience as well as thorough classroom instruction by experts to enable you to qualify for the better-pay positions in the field of meteorology. *That's exactly what you get at* SPARTAN! The extensive training facilities of the Spartan School of Meteorology include four fluorescent, lighted laboratories completely equipped. You are trained with the latest type of weather instruments. Top-ranking men provide skilled personalized instruction. You receive actual experience at the school's weather station and observation tower.

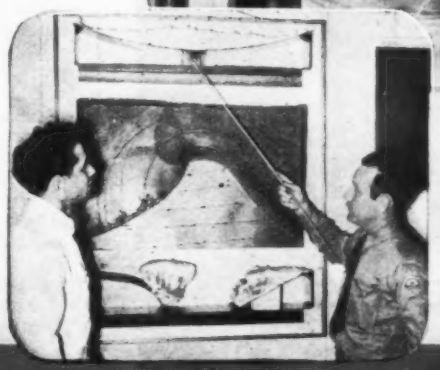
The SPARTAN School of Meteorology has received praise from the Air Forces, Civil Service and Airline meteorology department heads for the thoroughness of instruction, methods of training, wealth of modern equipment and quality of graduates produced.

EXCEPTIONAL OPPORTUNITIES are ahead for *both men and women* in weather forecasting. The U.S. Army Air Forces, the Civil Service and Airlines need such trained personnel. Graduates of the SPARTAN School of Meteorology are stepping into good-pay positions in weather departments of the airlines and other branches of the aeronautical industry. Others have received rapid advancement in the armed forces and now hold commissions. You can be of greater value to your country as a weather forecaster when called to military service—*and you can be ready for a post-war lifetime career as a professional meteorologist.*

Continue your education at this University of Aviation where you are assured advantages obtainable at no other school of its kind.



• (Above) Atop the Spartan Observation Tower.



• (Left) Technical subject made easy to learn by visual projects.

Essential to the War Program

Every consideration for deferment from selective service is extended to meteorology students, many of whom join the Air Forces as technical specialists, as instructors in Air Forces training schools, airlines handling the ferrying of aircraft to different parts of the world, the Weather Bureau, and other agencies of the government.

SPARTAN SCHOOL OF AERONAUTICS
DIVISION OF SPARTAN AIRCRAFT COMPANY

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DIVISION OF SPARTAN SCHOOL OF AERONAUTICS

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Send me your new Catalog, describing in detail the SPARTAN courses I have checked, also stating tuition and living expenses.

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CHECK COURSES YOU PREFER

- ☐ Aeronautical Engineering
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- ☐ Commercial Flight Instructor
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- ☐ Airline Pilot
- ☐ Fixed Base Operator-Pilot
- ☐ Aircraft or Engine Mechanic
- ☐ Radio Communications
- ☐ Private Pilot
- ☐ Weather Forecasting
- ☐ Women's Instrument Technician
- ☐ Parachute Rigger

level, working closely with the CAA and the local authorities.

Can we at least agree that control of the air space should be an exclusive Federal function? Probably not, although we can urge that insofar as it is practical and possible, Federal regulations should govern the flight operations of aircraft, but we are back to our troublesome problem of who owns and controls the air space above the land and water. Certainly the property owner has some rights. Just as certainly the state has some rights, as does each political subdivision. To some degree, each will be under obligation to exercise those rights in the public interest. It is easy to claim that the Federal Government preempts all air space above the sovereign lands and waters of the United States, but can it exercise control? Not without the aid of state and local governments, and strangely enough, although this thought is never mentioned, not without the aid of the individual property owner.

The objective and the declared intent of legislation and governmental administration affecting aviation should be the development of a strong aviation industry, free to exploit all of the possible beneficial uses of the aircraft. Governmental regulation and control of aviation is a by-product of this effort. Each level of government has an interest in developing a strong industry and these interests are interrelated and must be articulated.

Similarly, each level of government has duties and obligations which it and it alone can best perform. The need is for decentralization whenever and wherever it is possible. We have excellent machinery functioning for intergovernmental co-ordination. Similarly, the machinery is functioning for co-operation between government, labor, and industry. Within such a framework it becomes the duty and responsibility of the several states to create state aviation departments in accordance with the following general specifications and geared to achieve the following results:

First, a technical or engineering division, staffed with qualified men having the greatest possible background of aviation experience. This division will not be so concerned wth the "what" of an airport, since these standards and specifications will be provided at the national level, but it will be concerned with the "how, why, and when" of municipal and state airport and landing field development. It will be interested in passenger and cargo traffic studies, economic studies, and such additional research which may lead to a determination of the present and potential airport needs. It will co-ordinate its activities with other state divisions and the Federal Government in those multiple problems which are involved in the ultimate functional utility of airports created for the public use, with special emphasis on those phases which fall within the so-called "police powers" of the states and municipalities. The division will be concerned jointly with the Federal Government in the initial planning, the location, engineering, construction, zoning, and area requirements of the airport.

Second, a development and control division staffed again with qualified professional men, having a broad background in the field of aviation, which will undertake to stimulate and foster by all lawful means the use of aviation's products and services as they may apply to the special geographical, industrial, and agricultural conditions of the municipalities and the state. At the same time, this division must be prepared to exercise such reasonable control and regulation of a secondary and local nature which may be necessary to supplement those natural and rightful powers granted to the Federal Government under the commerce clause of our Federal constitution. This type of control and regulation will ultimately take many unexpected forms which cannot now be fully anticipated, involving public interest, public safety, and the abatement of nuisances.

Third, there will be need for an operation and management division staffed with qualified personnel, prepared to give special technical assistance in the extremely broad field of operational procedures and techniques which go to the very heart of the utility of the airport. It would be concerned with management procedures and practices within the structure of municipal and state government, and maintenance. This division may also become involved in problems of weather reporting, communications, and other functions supplementing the services provided by the CAA, in the interest of the continued and safe flow of aircraft. It will be vitally concerned with safety and the exertion of constant pressure toward the prevention of accidents.

Fourth, there must be an administrative division staffed with qualified people to insure smooth and orderly functioning of the aeronautics department and full co-ordination of the activities of its several divisions, and to further co-ordination between these divisions and other segments of state as well as of municipal government.

The department should integrate only those problems which necessarily must be handled at the state level and it should unhesitatingly pass along to the Federal Government those problems and functions which inherently are national in character. Municipalities with their airport boards, committees or commssions and the states with their aeronautical departments achieve a form of horizontal organization adaptable to efficient and relatively inexpensive administration. They are within immediate reach of the pilot and the aircraft user, and they afford the most practical and sensible means of approaching those governmental problems of aviation which are largely local in character. END

CHEMICAL DESALTER

A CHEMICAL "desalter" capable of converting seawater into drinking water has been recommended by the Naval Medical Research Institute and approved by the ATC and the AAF.

Consisting of chemical briquets compressed to the approximate size of a candy bar, and a small plastic bag, the kit occupies less space than a cigar box and weighs only 3½ pounds. Each briquet makes one pint of water, or enough for one man for one day. The number of briquets carried depends on aircraft space limitations.

Operation of the kit is simple. The desalter is put in the bag with the salt water and shaken or kneaded to speed the desalting process. As the briquet breaks up it converts the salt into a filterable sediment. The water is clarified and the flyer sucks it through the tube in the bottom.

"M"

STANDS FOR VICTORY...TOO

"That may sound like a trick remark to you folks on the home front, but I'm a lad who ought to know, so just let me 'shoot the breeze' a bit, and you'll see what I mean.

"Back around the turn of the year, I'm chauffeur of a Glory Wagon flying Purple Heart Corner on a milk run that isn't helping the Axis Supply Lines any. With forty-one successful missions over this same area . . . I guess we kind of overlooked that swell cover the pea-shooter boys had been giving us . . . Then all Hell broke loose around our ears. . . . . .

"For next time over, a weird looking bunch of bandits blitzed through us, and dished out such a mauling that the guys who got back sounded as wacky as the tale of the farmer who saw his first giraffe and yelped 'There ain't no sich animal'. . . . . .

"So we learned about jet-propelled Jerries the hard way and the beatings we took the next few trips did little but swell the flak-happy circle . . . for nothing we had seemed to be the answer. . . . . .

"But sooner than we'd any right to hope for, we found out, . . . and so did Mr. Goering's smug thugs . . . Flying top cover on our next mission came an escort of new THUNDERBOLT M's* that A-2 had been so hush-hush about . . . They looked just like any other 47's to my jaundiced eye . . . and probably to the eager beavers from Berlin. . . . . .

"We were both wrong . . . but this was their turn to take it, and no foolin'. . . . . .

"My geese were just lining out for their run, when down came the 'jets' again . . . but what a kick we got when right on the tail of these super-doopers streaked those THUNDERBOLT M's . . . diving three feet for every two of the startled Heinies. . . . . .

"Well, THUNDERBOLT fire power is no secret . . . and with this amazing increase in speed, it was just too bad for those new toys of the 'Supermen' . . . The 'jets' that were left, kept right on going and they haven't troubled us too much since . . . The Luftwaffe had thrown its Sunday punch . . . and found out again . . . that we had a wallop to more than match it."

*** THE PERFORMANCE OF THE THUNDERBOLT "M" AND ITS PILOTS HAS ESTABLISHED NEW STANDARDS OF PROTECTION.**

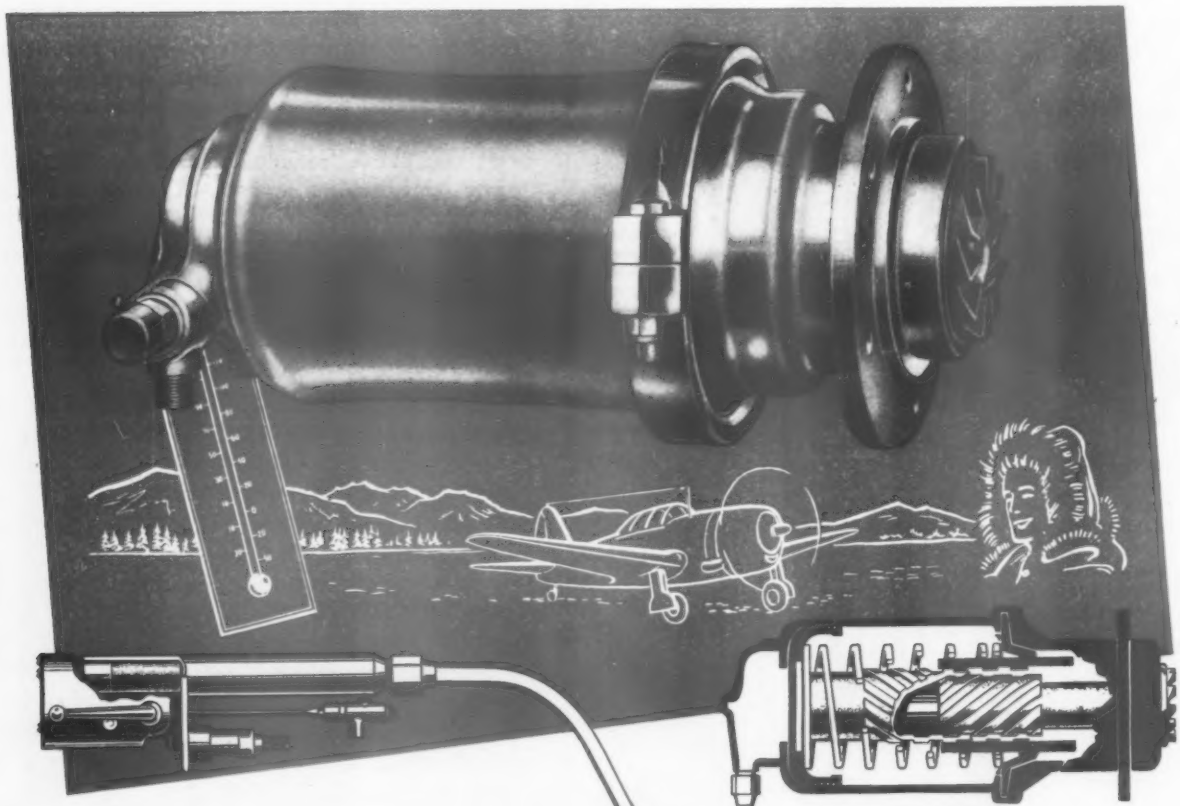
REPUBLIC AVIATION

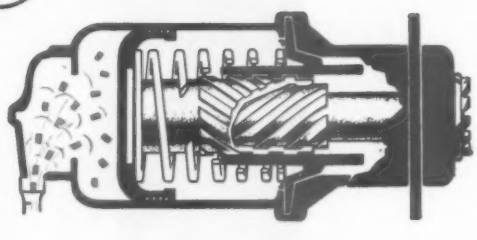
CORPORATION

kers of the Mighty Thunderbolt » » » » *Farmingdale, L. I., N. Y.* • • *Evansville, Ind.*

Specialists in ARCTIC STARTING

The Breeze Cartridge-type Engine Starter, designed for quick, positive action even at the lowest temperatures, makes possible an unlimited number of starts without the handicap of a heavy battery. Operating on the familiar spiral-drive principle, the lightweight, yet tremendously strong mechanism of the Breeze Starter transforms a 30-ton thrust into 180 RPM of the crankshaft. The various models of the Breeze Cartridge Starter, in service today with many of America's fighting aircraft, will spin into life engines ranging from 300 to more than 2000 horsepower.





1. Cartridge is placed in breech ready for electrical contact which will ignite quick-burning powder and drive slow-burning pellets into combustion chamber.

2. Combustion is completed in combustion chamber, rapidly building up pressure of gases on piston. Power stroke begins while helical splines impart accelerating rotary motion to clutch jaw.

3. As power stroke is completed, clutch jaw has spun engine through 3 revolutions. Exhaust valve in head opens and helical spring returns piston to starting position.

Manufactured under Coffman patents

Breeze BREEZE MARK

CORPORATIONS, INC.

Newark, New Jersey

Do Flight Engineers Have a Future?

(*Continued from page 57*)

The flight engineer's intimate knowledge of his aircraft and his supervision of the work is essential in maintaining airworthiness. "In-flight" servicing may also be performed on aircraft such as the *Clippers* and *Mars* where the engines and accessories are accessible from inside the wing.

2. Constant supervision of pressurization controls, manual mixtures or automatic spark, water injection, propeller controls and interior controls. On planes like the *Constellation*, the flight engineer also controls altitude and rate of climb within the pressurized cabin along with heating or cooling and ventilation for the full comfort of passengers. Before the take-off he sets the automatic controls for a pre-selected rate of climb, much slower than the actual climb of the airplane, and he also selects the maximum "altitude" to be maintained inside the cabin throughout the flight. In case of need he can "take over" from the automatic control and handle the cabin superchargers and pressure relief valves through a manual over-ride. These manifold services the flight engineer performs result in more efficient plane operation and reduced pilot fatigue.

3. "Cruise planning" and "cruise control." These include determining amount of fuel needed, rate of fuel consumption, power settings for distance to be flown, weather and upper air temperatures, length of take-off run needed with specific load, speed of optimum climb, best altitude to be flown, manifold pressure settings and r.p.m. necessary to attain altitude chosen, what change of manifold pressure and r.p.m. to maintain pre-selected cruising speed at cruising altitude, what gas is needed to make alternate airport if necessary, what throttle and mixture settings needed if altitude is changed, and changes necessary when temperature, wind direction and velocity change unexpectedly.

4. Reducing fuel consumption, one of the largest items of direct operating costs in airline operation. The flight engineer has proved from the very first that he can save his weight in fuel—plus the weight of any duplicated instruments—over a given distance. For example, let us assume a 200-pound engineer and 40 pounds of extra instruments stationed on a plane using an average of 600-h.p. on each of the four engines. If, by manual leaning in place of auto lean, the flight engineer can cut specific fuel consumptions from .44 to .42 at 160 m.p.h., he will save 240 pounds of gasoline in 800 miles. At all distances beyond 800 miles this saving may be utilized for payload. And this distance, according to transport planners, will be relatively short for four-engined aircraft operation.

As a matter of fact, most installations for the flight engineer actually show a weight saving. On the Martin M-130, Boeing B-314, Consolidated PB2Y-3R (*Coronado*), and Sikorsky VS-44A flying boats the engineer's station, while in the hull, is located in the wing center section. It thus becomes the nearest point in the hull for all engine gauge lines, wing fuel tank lines, engine and propeller controls and auxiliary system controls, such as carbon-dioxide extinguishers, wing de-icers, propeller de-icers and carburetor alcohol. To continue all these lines, control cables and wiring from the center section up to the cockpit would add tremendously to the empty weight of the plane. The cockpit simplification which the flight engineer's station permits also reduces maintenance time and cost. Weight of the few instruments that must be duplicated in the cockpit—manifold pressure gauges, tachometers and outside air temperature gauges, throttles and propeller controls—will not total much.

Under the subject of economy also belong the savings a flight engineer may effect in equipment maintenance and repair. It is much less expensive to detect a trouble before it develops than to repair or replace after failure. It's safer that way, too.

Specific needs of military operations have, for the most part, patterned these duties of the military flight engineer. But these are functions which also add to the safety and economy of any long-range operation. As such, they virtually guarantee a post-war berth in aviation for the flight engineer. But what about the picture from the prospective flight engineer's point of view?

Most of the airlines are reluctant to say anything specific about the post-war pay rate for pilots and flight engineers. At the moment, such lines as Pan American and American Export pay first officers roughly about twice as much as flight engineers; that is, captains receive about $950 per month and flight engineers approximately $550 per month. That means that the present pay scale rates the flight engineer and the co-pilot with approximately the same salary.

These wartime figures should not be confused, however, with those that will be applicable to commercial airline operation in the post-war period. There are, moreover, many variables that must be considered in determining the domestic airline salaries. Weather, terrain, day or night flying—these and other important factors must be considered and the pay situation is altogether fluid at present.

There are, of course, certain general requirements that must be met by each

VISUAL WEATHER INDICATOR

INCREASING air traffic which requires faster operation of air traffic control procedures has resulted in development of a new visual weather indicator by the Civil Aeronautics Administration.

Suggested by James E. Ryan of the Washington ATC center, the indicator is a box, on the face of which are several small lenses each bearing a standard weather code symbol. Current local weather conditions can thus be easily indicated by lighting the proper symbols, which are quickly read. One box is mounted above each traffic control board and is operated in the traffic center through the use of rotary switches. They can also be operated remotely from the Weather Bureau offices.

The CAA believes development of this indicator will increase the safety and efficiency of controlling airway traffic, especially in bad or borderline weather. Its use may eliminate reference to teletyped weather reports which lack sequence and are easy to misinterpret.

REQUIREMENTS FOR THE FLIGHT ENGINEER

Here are the requirements that assistant flight engineers must satisfy for one airline now employing them:

1. Minimum age, 22; maximum age, 34.
2. Completion of all requirements for a first-class aircraft and engine mechanic as published.
3. Sound physical condition, with restricted flight examination as required.
4. Completion of a tour at a foreign station with a satisfactory rating.
5. Aircraft and engine mechanic's licenses with airline experience on aircraft and engine maintenance.
6. High school graduate with plane and solid geometry, trigonometry, and physics or its equivalent. Technical high school preferred; general college engineering background most desirable.
7. Proven mechanical ability and resourcefulness in an emergency as well as thorough understanding of the principles of operation of all components of the aircraft and engine.
8. Aptitude for superior mechanical work demonstrated by workmanship, personal tools and handling of same, person, clothing, and professional pride.
9. Be able to fill passport requirements.
10. Completion of a comprehensive training course.

To advance to the grade of Flight Engineer 2,000 flying hours are required and written examinations covering the following subjects:

1. Airline routes and alternates.
2. Operation manuals and circulars.
3. Engineering circulars.
4. History of the airline company.
5. CAA and airline regulations.
6. International air law.
7. Cultural knowledge of countries covered by the airline.
8. A practical working knowledge of the language of at least one foreign country served by the airline.
9. Aircraft maintenance check on latest equipment.
10. Emergency training.
11. Seamanship (theoretical).
12. Aircraft propeller (theoretical).
13. Modern cruising control (theoretical).
14. Loading and stability.
15. Qualify on all types of aircraft assigned.
16. Neat printing on all engineers' logs.
17. Completion of 2,000 hours.
18. Personnel relations; also, knowledge of prevailing rate of pay, advancement, schedule, etc., of the company.
19. When necessary, as new or unfamiliar equipment warrants it, a course at the factory on this equipment.
20. International law and international maritime law.

flight engineer. Consolidated Vultee Aircraft Corporation sets forth those requirements as follows:

1. He must hold an Aircraft and Engine Mechanics license.

2. He must have multi-engine mechanical experience. It requires about two years' experience in heavy aircraft to acquire a license. This experience constitutes his primary training—a considerable time compared with basic training time for other crew members.

3. He must receive specific familiarization training. Comprehensive courses in the complex systems of each plane must be completed.

4. He must have flight training and flight time. Actions and reflexes are different in the air. Thinking is different. A qualified engineer must have hundreds of hours flying experience so that he may be thoroughly capable in the event of emergencies.

5. He must be carefully schooled in routine duties as well as for performance under emergency conditions. He must learn to be assiduous in checking and rechecking his plane, never taking the word of anyone else as to its condition.

6. He must be trained in checking the airplane load for weight and balance to prevent overload conditions.

7. His training must also include instruction in recording flight data. It is his responsibility to make entries in engine log books and to prepare flight reports.

Based on current developments, it is believed that the Civil Aeronautics Authority will issue a flight engineer's rating similar to ratings now issued to pilots, except that the rating will be issued for certain manufacturers' type airplanes as well as horsepower. An engineer, for example, may be certificated for a multi-engined Consolidated Vultee, Douglas, Lockheed, Boeing, or Martin airplane, depending upon which planes he has been checked out on. Future requirements for a flight engineer's license will probably include possession of an A. and E. license, flying time as an assistant engineer, and successful completion of an examination covering flight engineering.

Elementary reasoning will show that the post-war flight engineer must be the most highly specialized member of a flight crew. Flying characteristics of large type aircraft are similar in many respects and a pilot can usually check out on different types without much difficulty. Radio equipment is largely standardized and even different systems can be fully understood by a licensed radio operator in a short time. The navigator is at home with his octant and other navigation aids in any type of plane or surface ship. But the flight engineer becomes a specialist on a large type of airplane only after considerable study of its extensive systems. The complex systems of another large plane may require months of study to understand thoroughly. If a flight engineer is transferred from one type to another, he must study with far more diligence than any other crew member. The new type may and usually does have entirely different engines requiring special study to learn their ignition and carburetor systems. The methods of making engine changes or removing a cylinder for repairs may vary considerably from those which he has used on another plane. Units of one plane may be electrically operated while another one may have an extensive hydraulic system. While instruments may be standard, the control system may be completely different. A different type automatic pilot may be installed.

The flight engineer, therefore, becomes a specialist on one type of aircraft until additional study and experience qualifies him to handle another. He is not available for immediate transition to another airplane as are other crew members.

In order to maintain these high standards, Consolidated Vultee and American Export Airlines provide class-room facilities and constantly revised courses for its staff of flight engineers. Officials cite this system as the chief reason for the companies' excellent safety record which shows hundreds of overseas deliveries for the Navy and Army without the loss of a crew member or an airplane.

The value of this comprehensive training program was conclusively demonstrated recently by three of Consolidated's flight engineers. During flight test maneuvers of a heavy four-engined airplane both units of the main landing gear were damaged and rendered useless. The engineers surveyed the plane to ascertain if further structural damage had occurred, then conferred with the pilot on preparations for a crash landing. A list of all items to be secured before the crash landing was carefully prepared and rechecked with the pilot.

In accordance with procedure outlined for just such emergencies, the oxygen system was emptied to reduce possibility of an explosion. All loose equipment was stowed in the tail section of the fuselage. The eight persons aboard were ordered to remain on the flight deck during the landing rather than in the aft part of the plane where certain equipment might break loose on impact with the ground.

To provide support for those not in the cockpit, the top of the navigator's table was removed and placed behind positions of the flight personnel. Radio equipment supported in the cockpit was secured to the aft part of the plane with rope to prevent it from being thrown forward on impact.

The four engines were set to run on the inboard tanks and fuel was transferred to the outboard tanks to reduce the quantity of gasoline behind the cabin. Fuel to the auxiliary power plant was shut off.

All hatches and doors were either removed or tied open. In crash landing the structure may twist or buckle, making it impossible to open doors or hatches to escape.

Each person was assigned to the safest position for landing, with parachutes and seat cushions used as back and head protection. The landing approach was made

A POSTWAR PLAN
for G. I. Joe

A MESSAGE TO MOTHERS AND FATHERS OF SERVICEMEN

Returning servicemen and women have a ready-made postwar plan in the "G. I. Bill of Rights" which recently passed Congress. Among its many provisions are such awards to veterans of World War II as tuition for vocational training plus a government guarantee on loans to enter or purchase a business. It is a *guarantee* of *opportunity.*

Knowing that after the war aviation will provide opportunities which will even surpass those offered by the automotive and radio industries after the last war, your sons and daughters in the service will be exceedingly interested in studying the career opportunities in aviation. California Flyers' School of Aeronautics has a limited number of pre-Pearl Harbor catalogs which factually describe various divisions of aviation, the opportunities, the training, and educational background necessary. Although it is obsolete in minor respect, the book is one that every young person considering a career will want. *It's free. There is no obligation.*

California Flyers, which is one of the nation's leading aviation schools, will accept no enrollments or deposits at this time. This famous school has completed an intensive training program for the U. S. Army Air Corps and today is entirely engaged in an important aviation project. Till the war is won, California Flyers must say, *"Sorry, no enrollments accepted."* But in the meanwhile, brand new *postwar aviation courses* which will meet *postwar aviation problems* are being created, and they will be well worth waiting for!

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with No. 2 and No. 3 engines stopped and propellers feathered to 45° from normal. Fuel valves to these engines were shut off. Generators, ignition and propeller switches for No. 2 and No. 3 engines were turned off. The pilot extended the wing flaps to 40°. The engineers assisted the pilot in operating the flaps, fuel valves and electrical switches. Immediately upon contact with the ground, No. 1 and No. 4 ignition and master switch were turned off. Almost instantly the fuel valves for No. 1 and No. 4 engines were closed, and the battery turned off.

These careful precautions—which no pilot could have managed on his own—prevented any serious damage to the airplane and its personnel during the landing. If a single detail had been overlooked by the engineers and pilots this particular emergency could have ended in a much different manner. This illustration—which could be multiplied many times over—indicates that the work of the flight engineer will be of ever-increasing importance. As airplanes become larger and as the size and number of engines increase, there will be constant need for more highly trained personnel in this field. While the planes of today require only one engineer, those of the future may require two or more. One glance at the engineer's panel on the *Mars*, *Constellation* and other airplanes in experimental stages is convincing proof of a bright future for flight engineers. END

AAF Film Unit

(*Continued from page 55*)

Pilots and antiaircraft crews in the Pacific area were having difficulty telling them apart, especially since the two planes are almost identical when sighted headon. Both a *Warhawk* and a captured Jap Zero were flown over the San Diego area and photographed from all angles and in all maneuvers. After the film was shown throughout the Pacific theater no further confusion over the two planes was reported.

Since the first weeks of the motion picture unit, when improvisation was the order of the day, more than 250 films have been processed.

One of the most important wings of the command is the flight echelon. Personnel of the echelon is now commanded by Maj. Frank Clarke, formerly a movie stunt pilot, who once flew a plane off a Los Angeles office building. Among its members are the daring pilots who provided thrills in hundreds of movies. Another member of the echelon is Maj. Elmer Dyer, noted aerial photographer who filmed the air sequences for "Hell's Angels," "Only Angels Have Wings" and many other movies. Attached to the echelon are from 12 to 20 planes, based on Metropolitan Airport, most of them twin-engined Beech *Kansas* trainers converted into camera planes.

The echelon started out with one plane, a *Hudson* bomber borrowed from Lockheed. Since then, *Havocs* have been transferred to the echelon; *Fortresses* and *Liberators* have been borrowed from other commands for long-range missions; the Vultee *Vigilant* high-wing observation plane has been converted into a camera plane for photographing ground operations, and the Boeing P-12 (obsolete biplane fighter) is used for acrobatic flying.

When a training film has been ordered by the Motion Picture Division of the Army Air Forces in Washington, the production office of the unit first "breaks it down" and assigns writers to do the scenario. Research experts are sent to Army air bases and technical schools to familiarize themselves with operational conditions. A crew of technicians, actors, a director and all their equipment is then dispatched on "location." The planes and equipment to be illustrated in the picture are obtained from other commands, and students and instructors are filmed in their daily routine. When the location shots are obtained, the shooting company moves back to the Culver City headquarters for interior scenes, musical background is provided and the film is edited.

Other films destined for the visual education of embryonic pilots, ground crew members, aerial gunners, radio operators, navigators and flight engineers are animated cartoons which drive home their points graphically and often humorously.

For instance, animation brings to life an oil gauge in a plane which crashed because the pilot failed to warm his motors. The oil gauge tells the pilot he should not have tried to take off without warming up the motor. Animated cartoons stress

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Smooth flying characteristics and luxurious appointments will provide new comfort for passengers who travel in postwar Commandos.

Adequate aisle space will permit walking through the big roomy cabin without annoying other passengers. There will be plenty of leg room between the seats themselves. Cabin temperature will be maintained at 70° with a complete change of air every two minutes.

Ample lighting will be provided by fluorescent ceiling fitments and individual reading lights that will not interfere with adjacent passengers.

The cabin will be so insulated that one may converse in a normal tone—and the mechanized sky-kitchenette will provide rapid service of foods, sizzling hot or properly chilled.

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FOR ACHIEVEMENT IN THE AIR

U. S. Navy's Grumman Hellcats on Combat Patrol

Grumman

AIRCRAFT ENGINEERING CORPORATION, Bethpage, L. I., N. Y.

the necessity for camouflage on airfields in the combat areas. The central character is a chameleon who tells the personnel how to camouflage themselves to blend with their surroundings, while the always-in-the-wrong character is Private Drip.

Drip disobeys the fundamental law of airfield camouflage by walking across the field instead of around it. Footprints can be seen by enemy reconnaissance flyers. A Zero flies over the field, sights Drip's footprints made on his frequent trips to the latrine and reports that, judging from the footprints, there is an ammunition dump on the field's edge. Jap bombers follow —and blast the Chic Sale devices that Drip had been using to splinters.

Regular training films also make their points of instruction by use of humor—even going so far as enlisting Mae West to help teach basic flying maneuvers!

She was cast in a training film demonstrating how to accomplish a basic flying maneuver, the "Lazy 8," which must be achieved by a "slow and easy" hand on the controls. She sings, "I Like a Guy Who Takes His Time" to point up the technique of the "Lazy 8," and after animated sequences show the right and wrong way of making the maneuver, she tells the trainees from the screen: "When you've learned how to do your 'Lazy 8's' come up and see me some time." Instructors have reported this classic invitation has been a great success in getting the point over to the students.

An early series was the "Land and Live" pictures showing survivors of crashes in the Arctic, desert, jungle and mountains how to live until they are rescued. Emergency equipment and kits are demonstrated and the use of parts of the crashed plane for making huts and metal snowshoes, among other ingenious ideas is illustrated.

But most of the films are technical, leading with flight characteristics of the various planes, the "nuts-and-bolts" pictures dealing with repair, equipment and installation, instruction to aerial gunners telling how to man their guns in all of the plane's turrets and positions, a series on the operation of radio equipment and pictures for the Air Surgeon dealing with medical problems in the Air Forces and the care of wounded being evacuated by air to base hospitals.

The present commander of the unit is Col. J. K. McDuffie.

The proved results of the training films, he says, indicate that visual education as conveyed by the motion picture has "contributed much to the success of the United Nations in every field of battle."

Recently, the unit issued a recapitulation of the films produced—except those of a secret and confidential nature—showing the following classifications and number of films made of each:

Aircraft recognition films, 16; "how to fly" various types of Army planes, 10; general orientation films, five; aerial gunnery, two; radio operation, two; air intelligence, six; flight maneuvers and various stages of flight training, 19; films on camouflage and condensation trails, seven; "land and live" series, six; for engine mechanics, eight; aviation medicine, four, and flying safety, two.

Intelligence officers are instructed in assessing bomb damage through training films, which point out how reconnaissance photos must be read to determine from the debris what kind of manufacturing has been smashed by raids, how many buildings have been gutted or partially destroyed, and how effective are the various types of bombings.

For the Air Transport Command, landmarks along the many routes used by the Ferrying Groups to Africa, India, China, Australia are photographed to delineate the air trails along which planes, supplies and wounded men are carried. This special unit is commanded by Maj. Pare Lorentz, formerly a producer of documentary films such as the "Plow That Broke the Plains."

Every phase of the training of every member of the Army Air Forces, from *Flying Fortress* pilot to tail gunner to the Intelligence officers on the ground who chart their aerial achievements, is outlined and explained on celluloid.

The training film section of the 18th AAF Base Unit is commanded by Maj. Robert Carson.

Also in preparation at the unit's headquarters are films showing the ferocity of the air war on the world's battlefronts. These films will probably be released for showing to the civilian population of the United States.

(*Continued on page* 111)

Swift, dependable remote control of Gun Turrets, Super Chargers, Turbo Regulators, Screw Jack Assemblies, Cowl Flaps, Radiator Scoops, Radio Antenna, Hand Crank Starters, Pressure Valves, Revolution Counters and other aircraft mechanisms is being handled efficiently with MALL Remote Control Flexible Shafting.

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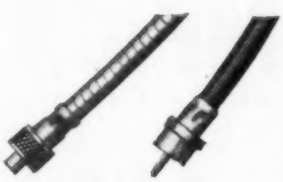

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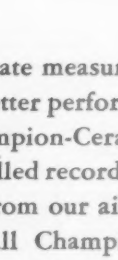
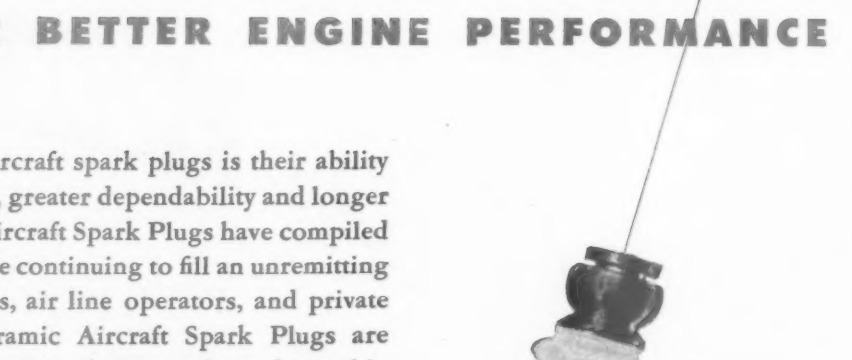


C34S—Shielded



(*Continued from page* 109)

Lieut. Col. William Wyler, who was dispatched to the Eighth Air Force in Great Britain in its early days, returned to edit "The Memphis Belle," a photographic account of the famous bomber and its crew and the part it played in the air war against the Nazis over Europe.

Some of the action sequences, showing Nazi fighters swooping on the bomber and the deadly duel between aerial gunners and their German adversaries, as well as the numerous blossoming of flak for hundreds of miles to and from the targets, were photographed by Lieutenant Colonel Wyler himself. He was awarded the Air Medal for participating in five missions. He was a top-ranking producer and director in Hollywood, and had just returned from filming Allied aerial activities in France.

Another former Hollywood director-producer who recently returned to the unit's Culver City headquarters with thousands of feet of film was Maj. Frank Lloyd, now on inactive duty, whose unit has been in the South Pacific focusing its cameras on the air war against the Japanese.

Maj. Clark Gable, also on inactive status, returned from England to edit orientation films for aerial gunners. He too glimpsed the *Luftwaffe* through gunsights and camera sights, and his film will show the combat problems met by gunners when they face the first enemy fighters.

For photographers trained by the 18th AAF Base Unit have been sent to every one of the Army Air Forces based throughout the world to record on film the enemy air forces in action—showing their tactics and type of equipment used—as well as Allied raids on enemy installations. These records are studied by United Nations strategists to guide them in planning further moves against the German and Japanese strongholds.

Not many hours after American planes return from their missions, the photographic account of their efforts and the resistance offered by the enemy is under close scrutiny by the military staffs.

The training of these aerial combat photographers is arduous and complete. They are sent to Lowry Field, Colo., for training in motion picture photography, then returned to the 18th AAF Base Unit for training in advanced newsreel technique. Finally they are sent to the flexible gunnery school at Las Vegas, Nev., for aerial photographers must man a waist gun when going on missions.

Then, usually under the command of a veteran newsreel man, they are sent to one of the Air Forces, each of which has at least one of the units. They "cover" the command's combat activities, fighters, attack-bombers, medium and heavy bombers, and the Service Command, the Quartermaster and the Air Surgeon. They are expected to record every activity of the Air Forces from supply dump to target and back again.

"Honor graduates" of the 18th AAF Base Unit's school for combat photographers have been highly praised and much-decorated.

The first to be killed in action was 47-year-old Lieut. Harold Tannenbaum, former movie soundman, who was trained at the Culver City headquarters.

He went overseas with Colonel Wyler's unit. On their arrival in England they found their equipment had been sunk with another ship in the convoy and cameras were borrowed from a Navy unit commanded by Lieut. Comdr. John Ford, another former Hollywood director. Lieutenant Tannenbaum volunteered to accompany the early Eighth Air Force raids over occupied Europe. And in a mission over St. Nazaire, the blasted Nazi submarine base, he was killed in action.

Lieut. James Bray, another trainee of the unit, was the first to shoot down an enemy fighter—two of them, in fact. A former newsreel cameraman, he was sent to North Africa with Lieut. Col. Sam Greenwald's unit, attached to the Ninth Air Force in Cairo. The latter was supporting General Sir Bernard Law Montgomery's epic chase of Marshal Rommel and his Afrika Korps from El Alamein to the final death trap in Tunisia.

On a mission over Messina on March 23, 1943, three Messerschmitts attacked the *Liberator* on which Lieutenant Bray was flying as photographer. He manned a waist gun and shot down one of the interceptors. The next month, over Naples, three Messerschmitts dived at his position, trying to knock out the waist gun. One more Nazi fighter went down in flames under fire from his gun.

Later he was awarded the Distinguished Flying Cross and reassigned to the Culver City training unit to help prepare other photographers for their duties.

In the same unit was T/S Jerry Joswick, who flew on the historic raid on the Ploesti oilfields in Rumania. Out of the squadron with which Sergeant Joswick flew as photographer and waist-gunner, only three of the *Liberators* returned. His shots of the raid were shown in newsreels throughout the Allied world.

With such a "faculty," the best equipment in the world and a tremendous background of battle experience, the 18th AAF Base Picture Unit looks forward to two crowning events, which it hopes to record with its cameras: the assault and capture of Berlin and Tokyo. Meanwhile they'll keep the cameras rolling on a score of battlefronts. END

ASC TIGER HUNTERS

by Sgt. William L. Brown, CBI-ASC

JAP Zeros are not the only big game that men of the Air Service Command in Assam, India, have helped to bag. Twice during a recent week steel hail from GI rifles brought down charging Bengal tigers fairly close to the open-air shops of this advanced maintenance and supply base. The Bengal cats are man-eaters once they acquire the taste; so, when one gets to foraging too near the airdrome, the Air Service Command mechanics oil up their rifles, board elephants and take the offensive.

The stories these soldier hunters tell rival the records of a Frank Buck safari. Their biggest thriller concerns a tiger that a five-elephant expedition flushed into the open. A quick shot wounded the beast and he slipped out of sight in the tall grass. One elephant pushed through the grass while the men on the other elephants stood by ready to fire. Suddenly the cat charged the elephant in the grass. He clawed the elephant's trunk and the pachyderm reared high in the air, sprawling its crew to the ground. Only the Indian driver remained astride the elephant's neck, jabbing at the tiger's snarling head with his goad.

GI marksmanship put an end to the dangerous situation when Corp. Green R. Smith, of Shiro, Tex., and Sgt. Lester J. Gearhart, of St. Joseph, Mich., sent slugs right through the cat's head. During a three-month period last year, the GI hunters chalked up four such kills. Their prize trophy is the skin of a Bengal beauty, a huge beast that weighed nearly 600 pounds and measured almost 10 feet from tip to tip.

How Fast Is Fast?

(*Continued from page* 32)

prow and the wake is a swirling, wave-chopped mass of foam as the water attempts to seek normal level and equalize hydrostatic pressures. This phenomenon, occuring at higher aquatic speeds, is not due to any physical change in the water but is caused by the increased friction between the water molecules as they try to get out of each other's way.

A similar principle applies to air. When an air molecule moves at subsonic speed it has time to telegraph its movement to surrounding molecules, which in turn are set in motion and a smooth fluid flow results. Any tendency to compress is dissipated from one molecule to the other. Under such conditions air acts very similar to a non-compressible liquid. When, however, an air molecule is moved at greater than sonic speed it has no time to telegraph its movement and is rammed unexpectedly against other molecules which in turn are set in motion and rammed against others.

This ramming of one molecule against the other without giving each time to flow smoothly out of the other's way results in the compressibility effect. Local pressure areas are built up which cannot dissipate because pressure changes are transmitted through air at sonic velocity.

The above is an elementary explanation of true compressibility. Unfortunately, however, when a third body is involved, such as a moving airfoil, there is no sharp dividing line where air ceases to act like a non-compressible liquid and begins to exhibit the compressible qualities characteristic of a gas. There is a considerable range of velocities just above the velocity indicated by the critical Mach number of the airfoil where air can't make up its mind. One instant compressibility is in evidence with a definite localized pressure area and shock wave; the next instant, due to some fluke not as yet thoroughly understood, the pressure area will be torn away with a part of the boundary layer, and a smooth aerodynamic flow will result.

These phenomena alternate rapidly, perhaps many times a second, and are responsible for the pitching and lunging of an airplane as it exceeds its safe terminal velocity. Under such conditions the air leaving the trailing edge of the wing may be likened to wet snow sliding off a high roof. It breaks up into chunks composed of air masses at different pressures, and these chunks strike the rear control surfaces with devastating effects. They literally knocked the twin tails off the *Lightning* in which Ralph Virden met his death.

Let us consider the effect of compressibility on a moving airfoil. As long as the velocity of the airfoil does not exceed its critical Mach number, any pressure change on its surface will be transmitted almost instantly to other areas with a resultant smooth aerodynamic flow. Now let us consider that the speed is increased to just beyond its critical Mach number. The leading edge of the airfoil contacts the air first and imparts the equivalent of its forward velocity. At the same time the vertical displacement is greatest at this point due to the curvature of conventional airfoil design. The sum of speeds generated by the forward velocity plus vertical displacement sets the air in motion at a rate exceeding sonic speed. Now a number of things start to happen.

Because the air near the leading edge is moving at super-sonic speed it cannot transmit pressure changes as rapidly as they accumulate. Thus a definite localized center of pressure is built up in the vicinity of the leading edge. This pressure accumulation continues until a shock wave of definite amplitude is established. Also, because of the super-sonic speed of the air mass, changes of pressure near the trailing edge cannot propagate forward to equalize pressure in other areas. Thus the shock wave is definitely trapped on the leading edge, unable to dissipate backwards as fast as it accumulates, and propagating forward into a wind that blows it back with equal and opposite velocity.

If the speed of the airfoil is again increased, the forward velocity plus a smaller amount of vertical displacement back where the wing surface is less curved will result in super-sonic air speed farther back on the airfoil section. Thus, as speed increases, location of the shock waves moves back toward the center of the airfoil chord.

The effect on aerodynamic efficiency of this unequal pressure distribution over the airfoil surface is self-evident. It is impossible to pre-calculate the lifting and pitching characteristics of a wing when centers of pressure cannot be established definitely. At the same time other factors enter into the picture, not as self-evident as unequal pressure distribution but none-the-less important in conjunction with speeds approaching the compressibility zone.

At sub-sonic speeds, drag increases as the square of the speed. But when the zone of compressibility is entered, drag suddenly zooms beyond all proportions to

(*Continued on page* 116)

BRONCO-BUSTING A MITCHELL

ON the field log-sheet of the airfield somewhere in Greenland the event was shown merely as:: "Emergency landing—B-25—no injuries." But to the men of the Ferrying Division, Air Transport Command, Capt. Emil Garske's bronco-busting feat of landing his *Mitchell* bomber sans nose-wheel was something for the books.

Checking out a "weather ship crew," one which flies ahead of ferrying flights to check weather conditions, Captain Garske (pictured at right) returned to the field and began what should have been a procedure landing.

Operating the landing gear controls brought forth a sound of ripping metal and an ominous hissing like the sound of escaping steam. The flight engineer, first to grasp the situation, seized the emergency hand pump for the landing gear and pumped enough fluid into the hydraulic line to get the main gear fully lowered. But the nose wheel stuck one-third down and it was impossible to force more fluid into the line.

Trying everything in the "tech manual" read by radio to Captain Garske failed to pull the wheel down, including abrupt pull-ups after stalling the big bomber at 6,000 feet. He then decided to land it as is—but bronco style.

He radioed his plan to the tower, requesting that the crash truck and two jeeps carrying as many men as possible race alongside and behind him as he landed. Instructing his crew to crank the flaps full down and stay as far forward in the rear compartment as possible, Captain Garske made a long, low approach at the

slowest possible speed—120 m.p.h. The moment the wheels touched, the crew rushed tailward, shifting the weight aft to help keep the nose up.

The jeeps loaded with men, including the colonel in command of the field, raced along behind, gradually caught up with the tail and rode under it. Men leaped onto the tail. Their weight did the trick—the tail teetered to the ground, sparks flying in all directions. Men held their breath lest the sparks from the now white-hot tail bumper ignite the 100 octane gas in the bomb bay tanks. But the plane rolled to a stop and the danger was over.

In a day or two the *Mitchell* was repaired and Captain Garske was back in it—checking out another weather ship crew.

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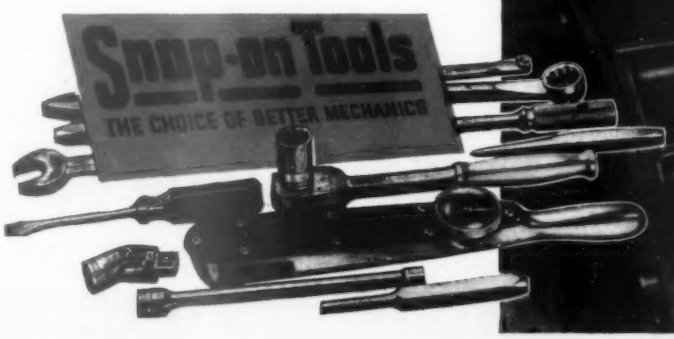
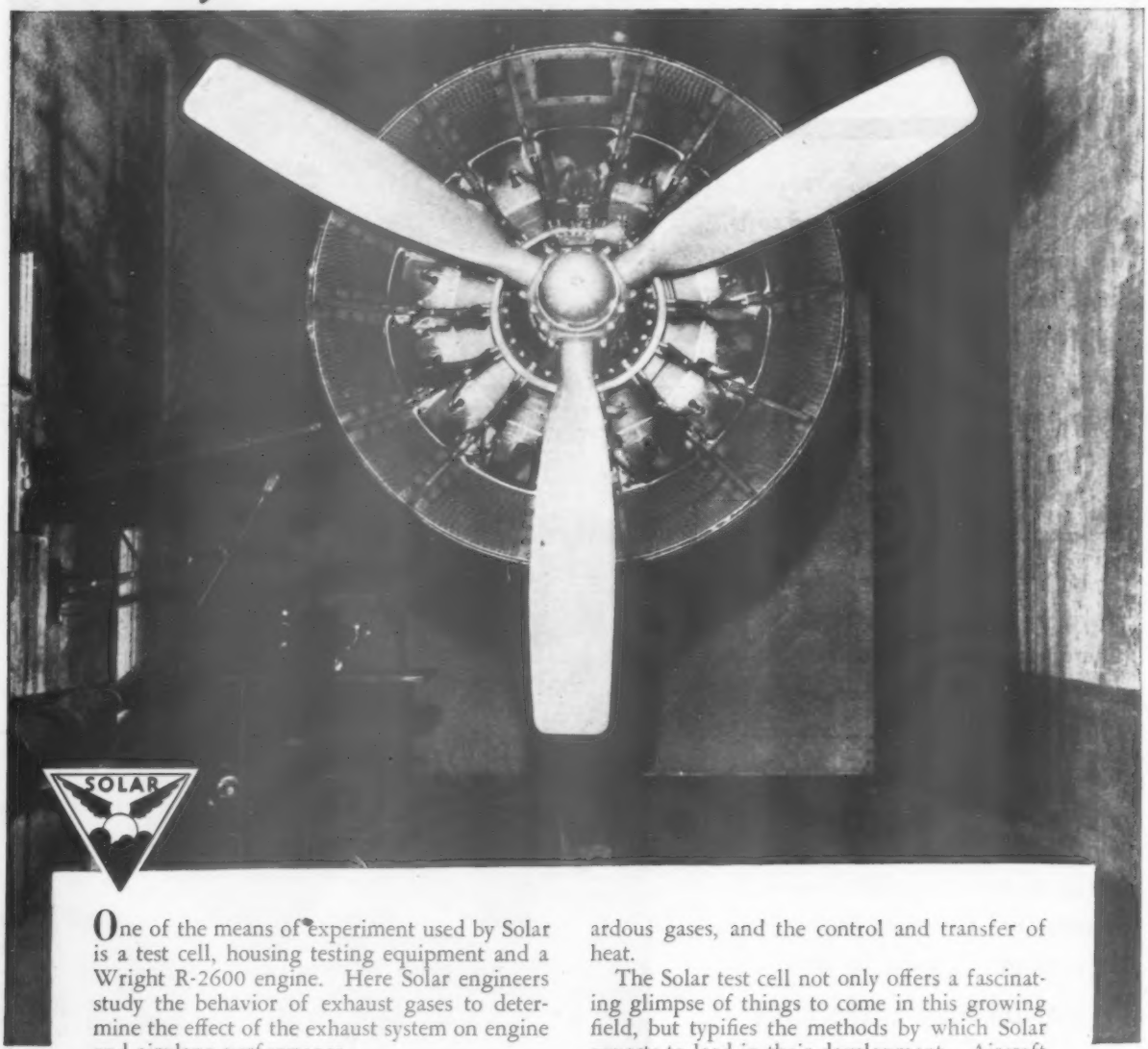


Looking into the Future FROM A TEST CELL



One of the means of experiment used by Solar is a test cell, housing testing equipment and a Wright R-2600 engine. Here Solar engineers study the behavior of exhaust gases to determine the effect of the exhaust system on engine and airplane performance.

By such methods which eliminate guess work, Solar exhaust systems have been constantly improved for fifteen years, and today rate higher in performance yet are lower in price than ever before.

A vast new field is opening up for products which, like exhaust systems, have to do with the thermodynamics of exhaust gases . . . jet propulsion and gas turbine engines, heat exchangers, and accessories for the recovery of waste heat energy, the elimination of hazardous gases, and the control and transfer of heat.

The Solar test cell not only offers a fascinating glimpse of things to come in this growing field, but typifies the methods by which Solar expects to lead in their development. Aircraft manufacturers are invited to consult Solar on their problems in this field.

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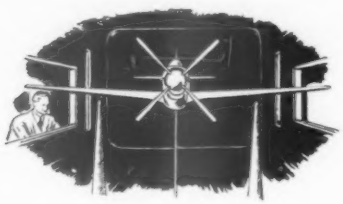
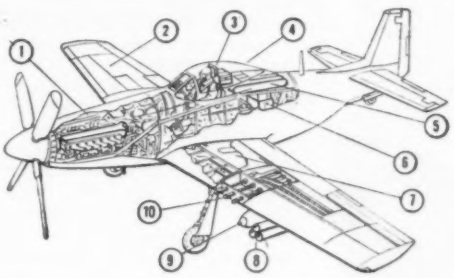


It took North American only 127 days to design and build the Mustang. The Mustang won its spurs in dog fights, intruder raids, train busting. First P-51 was test flown October 26, 1940 — on Standard of California Aviation Gasoline.



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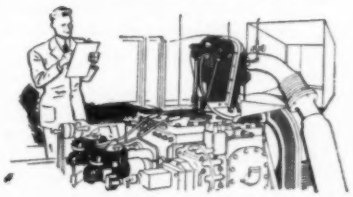
10 Three 50-Cal. Machine Guns in Each Wing

Present AAF Version (diagrammed above) is called world's fastest propeller-driven fighter at 450 m.p.h. Each Mustang comes off production line with its tank full of Standard Aviation Gasoline. North American Aviation, Inc. has used Standard Aviation Products since the commencement of their operations in California.

With six 50-caliber machine guns, two 1000-pound bombs, six bazooka tubes, the Mustang can fight anything the enemy offers. Here is what P-51 pilot sees diving on gun emplacement.

New gasoline being tested in engine which simulates conditions of actual flight.



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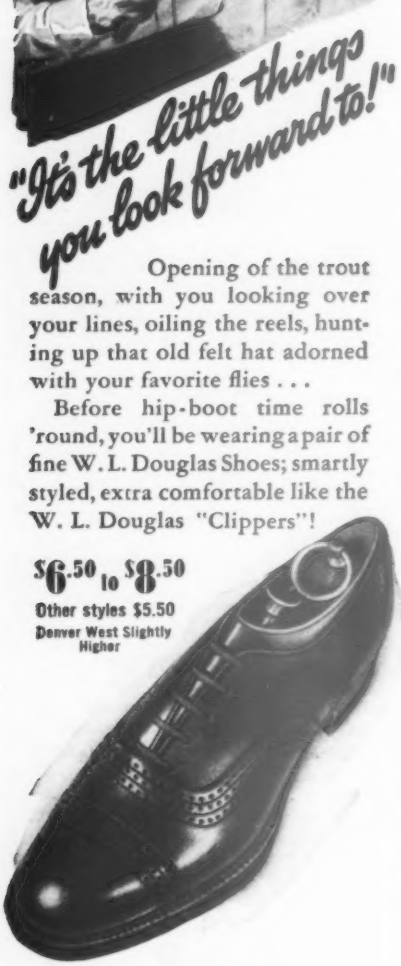

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(*Continued from page* 112)

increased velocity. This is due to two reasons. First, the shock wave itself produces a front with a very appreciable drag coefficient. Secondly, the boundary layer that clings to the airfoil surface as long as the pressure is constant over all areas is disrupted and torn away by the pressure discontinuity across the shock wave area. The sum of these two new drag components, resulting from compressibility, almost exceeds the imagination. For a 20,000-pound airplane flying at 40,000 feet altitude, power requirements would jump from 5,000 h.p. to 42,000 h.p. to increase the speed from 500 to 600 m.p.h. This takes into consideration that somewhere between 500 and 600 m.p.h. the plane would exceed its critical Mach number and enter the compressibility zone

A common question concerns the ultimate speed possible to attain by flying through the air. A more sane question would concern the effect that compressibility will have on airfoil design, power plant construction and propulsion. Leaving out such nebulous dreams of speed that the airplane would burn up due to air friction, like a meteor when it enters the earth's atmosphere, let us consider immediate future possibilities in the light of facts that now may be divulged.

Propeller tip speeds are limited by the same laws of compressibility that limit airfoil speed. Increasing the number of blades on a propeller to increase blade area without increasing diameter, thus keeping tip speed down, is limited by one blade interfering with another. Contrarotating propellers are highly efficient from the standpoint of blade area and torque reduction but here again tip speeds must not exceed sonic velocity. Thus it seems that any possible combination of propeller installation has limitations.

Jet propulsion offers a solution to the propeller problem. With either jet engines or rockets, propulsive force may be applied to an airplane regardless of compressibility. With the propulsion problem well on the way to solution, we still have to design an airfoil that can secure dependable lift despite compressibility effects.

Lockheed engineers have recently designed a wing flap that will aid fighter planes to pull out of a high-speed dive where compressibility has been encountered. This flap, however, acts as a spoiler to create a counter-turbulence to that generated by compressibility and promises little in the way of increasing the level-flight speed range.

The greatest step to date toward whipping the compressibility problem has been accomplished by NACA engineers in the development of the laminar flow airfoil section. Due to the thinness and modified curvature of the laminar flow airfoil, its critical Mach number is considerably higher than that of other airfoils in current use. The main drawback to a laminar flow wing is its loss in lifting moment at low speeds. This necessitates excessive take-off and landing speeds. Engineers, however, admit the possibility of an adjustable laminar flow airfoil, one that can be altered in shape to provide sufficient lift for low speed take-off, minimum drag during acceleration at subsonic speeds, and with further adjustments to compensate for air flow changes as the plane approaches and enters the compressibility zone.

Is there a possibility that air speeds will greatly exceed sonic velocity? Though conjectures in this direction are entirely theoretical, aerodynamicists are inclined to agree that such speeds are highly probable. The greatest deterrent to speed, they believe, lies in that range of velocities where compressibility and normal air flow alternate at rapid intervals, thus causing a turbulence that is difficult to control. It can be mathematically predicted that less power will be required to propel a plane at super-sonic speed than that required for dragging it through that range of velocities where air flow characteristics alternate in rapid sequence.

A few engineers have hazarded a prediction on ultimate aircraft speeds. In many cases such predictions have been proved wrong; in all cases such predictions are looked upon by other engineers as sensationalism. Right now great stress is being placed on military air speed.

It is quite evident that the nation which can turn out the fastest planes will be a nation to reckon with in maintaining post-war peace. Thus it is necessary that we continue to study the problems of high speed and develop airplanes that will overcome the difficulties inherent with compressibility. The application of such speeds to civilian and commercial flying is still in doubt but is being studied.

Meanwhile our fighter pilots owe a lot to the men who went "over the edge" to study the compressibility problem. It takes a lot of nerve to climb up there on the edge of nowhere, then tip over that edge into a power dive that carries one into a range of velocities where the best minds can only guess what will happen! END

Strange Accident

AN unnamed *Lightning* pilot, flying a photographic mission over enemy-held territory in August, 1943, had one of the most unusual accidents ever recorded in AAF annals. According to Maj. Ivor M. Campbell, MS, AUS, in a recent issue of The Journal of Aviation Medicine, Flight Officer Blank was flying in a heavy cloud formation at 35,000 feet when his plane was suddenly carried up to 40,000 feet by a violent updraft.

Possibly the altitude was higher than 40,000 feet because of instrument lag. At this point, the *Lightning's* tail assembly was violently wrenched off by the turbulence. The pilot released safety belt, pulled back the hood and stood up. Suddenly his forehead was struck so heavily by hail stones that it was a mass of bruises.

The pilot sat back on the seat and was unable to stand up because of the violent centrifugal force of the spin. At 25,000 feet the spin had slowed enough for him to ditch the plane. He descended by free fall through the cloud and pulled the rip cord at about 5,000 feet.

POST WAR AVIATION OPPORTUNITIES
Bulletin

VOLUME 1 NUMBER 6

Airport Tower Operators to be in Demand for Postwar Air Traffic Control

Civil service jobs as air traffic controllers are expected to be open to many officers and men of the air forces when victory is won.

At present, there are only about 300 airports in the U.S. with tower control. However, some idea of the future of airport control is seen in the Civil Aeronautics Administration program for postwar airport development in the U.S. which calls for 6,000 fields. True, not all these fields will require controlling, but if postwar traffic estimates of 200,000 or more planes prove valid, most of them will.

INTERNATIONAL POSSIBILITIES

In addition, it now appears that the C.A.A. system for handling airway traffic will be adopted by the other nations of the world as indicated at the recent international Civil Aviation Conference at Chicago.

If this happens—and the use of one standardized system is essential—then trained men from this country will be needed in all parts of the world to install and teach traffic control.

REQUIREMENTS

C.A.A. physical requirements for traffic controllers are high as regards hearing, vision, etc. Applicants must be free from chronic diseases such as stomach ulcers, hay fever, nervous disorders, etc., but physical disability such as the loss of a limb need not bar discharged personnel.

Interior of Salt Lake City control tower. Jobs as C.A.A. traffic controllers are opening already for discharged airmen.

Naturally, personnel who have had experience directing military air traffic are preferred. Such people will be able to step directly into advanced positions without further training. But pilots, navigators, bombardiers, et al., will find their knowledge of traffic patterns, airlanes and the physical problems of maneuvering aircraft a distinct asset in applying for this type of work.

This is readily understandable, since no civilian operations at present begin to approach the complexity and responsibility involved in participating in and controlling large-scale missions and strikes.

Educational requirements for these jobs vary according to the experience of the applicant. In general, four years of high school is the minimum schooling accepted.

PENSION RIGHTS

Pay is in accordance with established civil service rates for various grades of controllers. In addition to this base pay, C.A.A. operators receive overtime compensation and of course are eligible for pensions under the civil service regulations. In this respect, war veterans receive the usual civil service bonus preference of five points on their job examinations.

(NOTE: At present, the Civil Aeronautics Administration is without funds for such a large-scale development of air traffic control as is mentioned in this bulletin. However, the marked increase of civilian air travel that will undoubtedly come with peace will demand an accompanying expansion of regulation, and for this reason it is assumed that necessary funds will be allocated.)

The sixth in a series of bulletins designed to acquaint ground and flight personnel of the Army, Navy and Marine Air Corps with new developments in the field of commercial aviation. Union Oil Company does not believe the war is won, but we do think many members of the air forces are wondering what they will do when peace comes. We believe they will be interested to know of any opportunities which exist for them. Inquiries are welcome, and we will be glad to furnish information to interested personnel. Address—Aviation Dept., Union Oil Company, Room 700B, 617 W. Seventh Street, Los Angeles 14, California.

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76

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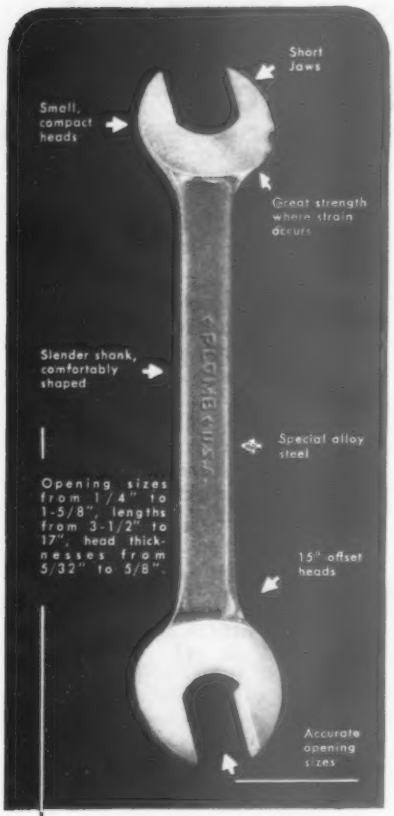
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FINE HAND TOOLS

War Workers' Flying Club

(*Continued from page 27*)

friend a ride" is subject to immediate dismissal from the club. An unfavorable name for the club and airport results from such action and an accident at such a time can result in serious legal action.

Recently the Aircraft Owners and Pilots Association reported that a large insurance underwriter had cancelled all insurance policies on flying club aircraft because it had concluded that flying clubs are poor risks. AOPA warns that adoption of such action by other insurance companies would doom all flying clubs.

Such a trend, in Goggin's opinion, can be forestalled by rules of conduct and proper supervision of operations. He cites the instance of one club member who was discovered flying below the prescribed limits set forth in the Civil Air Regulations. This offender was reported by the club to the CAA authorities, who promptly lifted the guilty pilot's license. Similar action was taken against a pilot who made an unauthorized cross-country flight. Goggin emphasizes that unyielding discipline and adherence to the CAR, the operator's regulations, and the constitutional by-laws of the club are necessary to success.

Costs of operations must be kept within the absolute minimum if expansion is to be obtained. Accumulation of a cash reserve is vital to growth and the whole flying club operation must be based on sound, rigid business economies. Goggin specifically indicates these "musts": (1) assure yourself of a cash reserve to carry over the "lean times," when weather will not permit flight. Goggin's club keeps an available cash reserve of $3,000 for this or similar purposes; (2) all equipment should be kept in tip-top shape; laxness in mechanical and structural attention to the equipment is not only more costly in the long run but lowers safety; (3) closely follow the regulations governing the hours of engine operation prior to periodic check and overhaul and (4) always use the fixed base operator's mechanics to make all required adjustments and repairs necessary.

Another vital factor is keeping adequate insurance on the aircraft used. Goggin suggests a minimum premium of $300 per airplane per year.

The prime purpose of establishing a flying club is to provide the *average* person the benefits of student instruction and solo flight time at reasonable cost. "In our club," Goggin explains, "no one 'shells out' money for some necessary purpose. Rather than create resentment by such a practice we hold dances and other social events from which the needed funds are raised through our ticket sales. This not only accomplishes the financial purpose but creates good-will among the club members."

Selection of an airport and operator whose facilities are reasonably adjacent to the members' place of employment should be given first consideration. A flying club requires the good will of the fixed base operator; friction and disagreements can often be fatal—to the flying club. For those operators who believe that flying clubs operating on a not-for-profit basis reduce their own sources of revenue, Goggin presents statistics.

First of all, the operation principles of the operator and flying club are different. In dealing with the flying club, an operator is entitled to a legitimate profit which is derived from his hangar charges, mechanics' fees and increased sale of gas and oil. His income is swelled further by sale of flying accessories, caps, jackets, etc. to club members.

Flying clubs reach individuals from industrial plant groups who might not otherwise fly because they cannot afford to pay the operator's fee.

Citing actual figures of his own group, Goggin shows where a student in the flying club, averaging about 65 hours before acquiring a private license, spends approximately $231 to obtain that license. This amount is based on an average of 10 hours dual instruction at $6.60 an hour and 55 hours of solo flight at $3 an hour. In contrast, Art Schelter, chief instructor for Tufts Edgecombe, Inc., the fixed base operator at Pal-Waukee airport, estimates the average student under the operator's tutelage obtains his private license in about 50 hours.

Using the same 10-hour dual instruction average, but at $11 an hour plus 40 hours solo flight time at $7 an hour, the student spends $390 in quest of his private ticket from the fixed base operator. This total sum is reduced somewhat when "block time" is purchased. Advance payment of $135 entitles the student to $150 in flying time, representing a 10 per cent reduction on the lump payment. Those students able to pay for two "blocks" of time, or $270, are only about 20 hours away from their private license. The difference in the club's and operator's figures represents the latter's well-deserved profit.

Harmony between the airport operator and the flying club is essential to the well-being and prosperity of both. Al Tufts, operator at Pal-Waukee, and Schelter both believe that a *properly* managed flying club is an asset to any airport. Rather than unfavorably affect the operator's volume, capably supervised clubs will, in the course of things, bring about a boom in general flying interest tending to increase student enrollment with the operator as well as the flying club. Also, advanced flying club students wishing to increase their horsepower rating will rent the larger equipment of the base operator. Goggin adds to his list of rules for successful clubs the one which specifically states there shall be no interference with the operator's students. Solicitation of such students is forbidden and any such student who voluntarily seeks admission to the flying club is politely but emphatically turned away.

The basic essentials of forming a flying club, says Goggin, take root in the formation of an executive board, election of a president, secretary-treasurer and two or three directors. This should be followed by incorporating not-for-profit. Costs of

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We are proud that they could, during their training, depend on the steady surge of Red Seal Power as we, today, can depend on their world-famous fighting ability.

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Awarded to the Detroit and Muskegon Plants of Continental Motors for High Achievement

Continental Motors Corporation
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MUSKEGON, MICHIGAN

Your dollars are power, too, — Buy War Bonds and Keep Them

this procedure vary with state laws but in general should approximate $10. No shares are issued in Goggin's group, and executive and administrative powers are conferred upon the directors elected by vote of club members. This tends to escape a haphazard method of directing club activities and affixes responsibilities upon those most qualified to assume them.

Appointment of a flight director is also necessary, Goggin believes. This officer must possess a thorough knowledge of flight instruction procedures and of the club constitution and by-laws. He is responsible for creating and maintaining a flight schedule assuring all members equal flight time in the aircraft. The Chicago group's flight director is Willis ("Bill") Clark, a former instructor at Thunderbird Field, Ariz., with a total of 2,400 logged hours. Another instructor, diminutive Sally Duncan, with 1,200 air hours, can take her place with the best instructors, says Goggin.

Goggin suggests use of either an alphabetical or numerical system of alloting flight time. The appointment method which requires the member to make advance arrangements and obtain confirmation from the flight director can also be used. This officer is authorized to cancel and release flights and can ground a fledgling when circumstances justify. Such a policy dovetails with that of the base operator. When the operator deems it advisable to cancel flying operations because of inclement weather the club must likewise suspend activity. The flight director is also responsible for training students in the proper pattern procedures used by the field or fields, as well as digesting the "NOTAMS" posted on the bulletin board. These Notices to Airmen give changes in identification or obstructions now present at or removed from different fields. He must imbed in members sane and beneficial flying habits that will automatically become a sub-conscious part of his or her flying ability.

Since a long and useful life for the airplane is a foregone requisite, Goggin's group requires all members to know and exercise established rules governing the airplane's operation. Carelessness is not tolerated. Where a group of novices is involved, however, the problem of accidents and the resultant responsibility for affixing blame arises. Widely separated conditions and circumstances require hearings by the board to determine if the club member was at fault and to what degree. Disposition of such matters should be incorporated into the by-laws, says Goggin, with specific penalties for thoughtless or careless handling of the airplane being stated and understood by all members. Wording of this by-law will depend largely upon the type of insurance covering the equipment as well as a clear definition of what constitutes "pilot error."

Pointing to a young girl hurrying off to a waiting plane, Goggin commented: "That young lady, Dorothy Malin, exemplifies what we are trying to accomplish in our not-for-profit flying club. Dorothy is a Douglas employee—her husband is a *Mitchell* bomber pilot. When he comes home they'll have a common bond of interest and the ground-work necessary to realize their ambition—to operate an airport of their own. And then there's Lee Kidd, another club member with a husband in the Army Air Forces. These girls are but two of the many members who are laying a solid foundation for a place in post-war flying."

With a total membership of almost 300 persons, of whom half are women, Goggin's group believes firmly in the adaptability of incorporated flying clubs to advance private flying. Twelve members who have become certificated private pilots are evidence that flying clubs can and do produce competent pilots. As Goggin says, "None of these members are of the 'hot-pilot' variety. Harvey Holtz, with 90 hours and a private ticket, heads the group. That proves we're not running a flying school—we're just giving the average Joe and Jane in our defense plants and offices a chance to fly. They can keep on flying on their membership card so long as they abide by the rules. Once they gain their private license they may continue up the ladder with a higher horsepower rating—a commercial license and perhaps even an instructor's rating. We're just glad and proud that we were able to give them their start."

Such a club, with hard, fast rules operating on a non-competitive not-for-profit basis offers safe flying at low cost, efficient instruction and fellow members with the same flying interests and goals. It also presents not only a plan for gaining that prized slip of paper—a private license—but an expanding horizon for post-war flying. END

For Men Who Really Know Pipes
TRANSPARENT MOUTHPIECE
MOUTHPIECE TUBE prevents backflow of moisture
CONDENSING CHAMBER traps and holds bitter juices and sediment
BOWL GUARD keeps shank and bowl dry
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CHAMBER GUARD bars tobacco fragments from bit
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$1.50
Selected Briar
Royalton CROWN
Cool, dry smoking is half the pleasure of a pipe. Royalton Crown redoubles your satisfaction because its six patented features 'wring' the smoke dry as it passes from bowl to mouthpiece. Every puff is dependably free from strong juices and tobacco shreds. Result: an everlastingly dry pipe in a class by itself for complete smoking satisfaction.
HENRY LEONARD & THOMAS, INC. • OZONE PARK, NEW YORK

Life Rafts

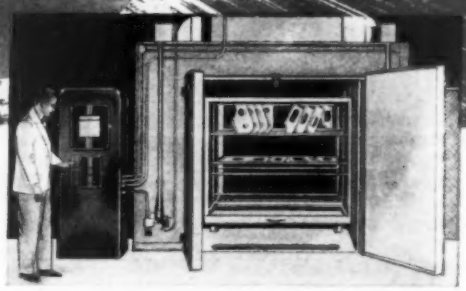
NEW life rafts being used for Army Air Forces flyers are painted blue on the bottom so sharks won't attack them. In general, several types of rafts are being used by the AAF to save men forced down at sea.

The largest is designed primarily for heavy bombers, weighs 106 pounds, has an over-all length about the same as a large row boat but can carry 2,500 pounds of men and equipment. Packed into a small compartment in the plane it takes up little more room than a large suitcase. Fastened securely in small water-tight compartments is a series of kits providing food, water and patch materials.

Also in separate kits are sail, sea anchor, pyrotechnic pistol, oars and a small carbon dioxide cylinder in the bow which inflates the raft. Wooden oars are in two pieces which fasten together with a push-button snap. A similar raft is being produced to be dropped from planes to survivors of torpedoed ships.

The smallest raft, designed for pursuit and fighter planes, is the one-man parachute pack type. Fitting into a small canvas pack attached to the parachute seat harness, it serves as a padded cushion as well as a safety device and fits into the bucket seats of all fighter planes. Inflated, it looks like an elongated inner tube with a bottom in it.

RYAN PRODUCTION ENGINEERING DEVELOPMENT NO. 28-30.18



Faster, Lighter Aircraft, Greater Pay Loads through New Techniques in Processing Aluminum Alloys...

How to develop airplanes capable of carrying greater pay loads at higher speeds by reducing structural weight? That's the aeronautical engineer's basic problem.

To accomplish this end could a metal be found which had the lightness of Aluminum and the strength of steel? Yes, Aluminum alloys could be post-aged to give them this much desired strength. But, the process so reduced the corrosion resistance of the metal that full advantage could not be taken of this development.

Ryan metallurgists tackled the problem and came up with a procedure which yields a light corrosion-resistant alloy with the strength of low carbon steel.

Ryan engineers have been *first* to make full use of this weight-saving development in the design and construction of aircraft. This advantage, which adds to the deadliness of American warplanes, will be equally valuable to the peacetime planes of the future.

THE PROBLEM: How to take advantage of the extra strength imparted to Alclad 24-S by the post-aging process. The strength of this metal, composed of an Aluminum alloy covered with a thin deposit of pure Aluminum, may be increased by post-aging. However, this has always been accompanied by a loss in corrosion resistance which prevented aeronautical engineers from completely utilizing this advantage. The aging reduced the galvanic potential between the alloy and the clad Aluminum and removed the electrolytic protection it afforded.

THE SOLUTION: Ryan research found a way to obtain the strength increase and maintain high corrosion resistance: The Alclad is placed in an oven and held to a temperature of 365° F. for ten hours. This induces a copper precipitation and raises the tensile strength at least 20%. Then the corrosion resistance is restored by anodizing a thin layer of oxide on the surface and spraying it with a zinc chromate primer.

THE ADVANTAGES: By ordering specified stock, post-aging at carefully controlled temperatures and anodizing and priming, Ryan has created new possibilities for Aluminum alloys. The entire aircraft industry may now have the benefit which this metal, with Aluminum's lightness and steel's strength, gives to every designer and builder of airplanes.

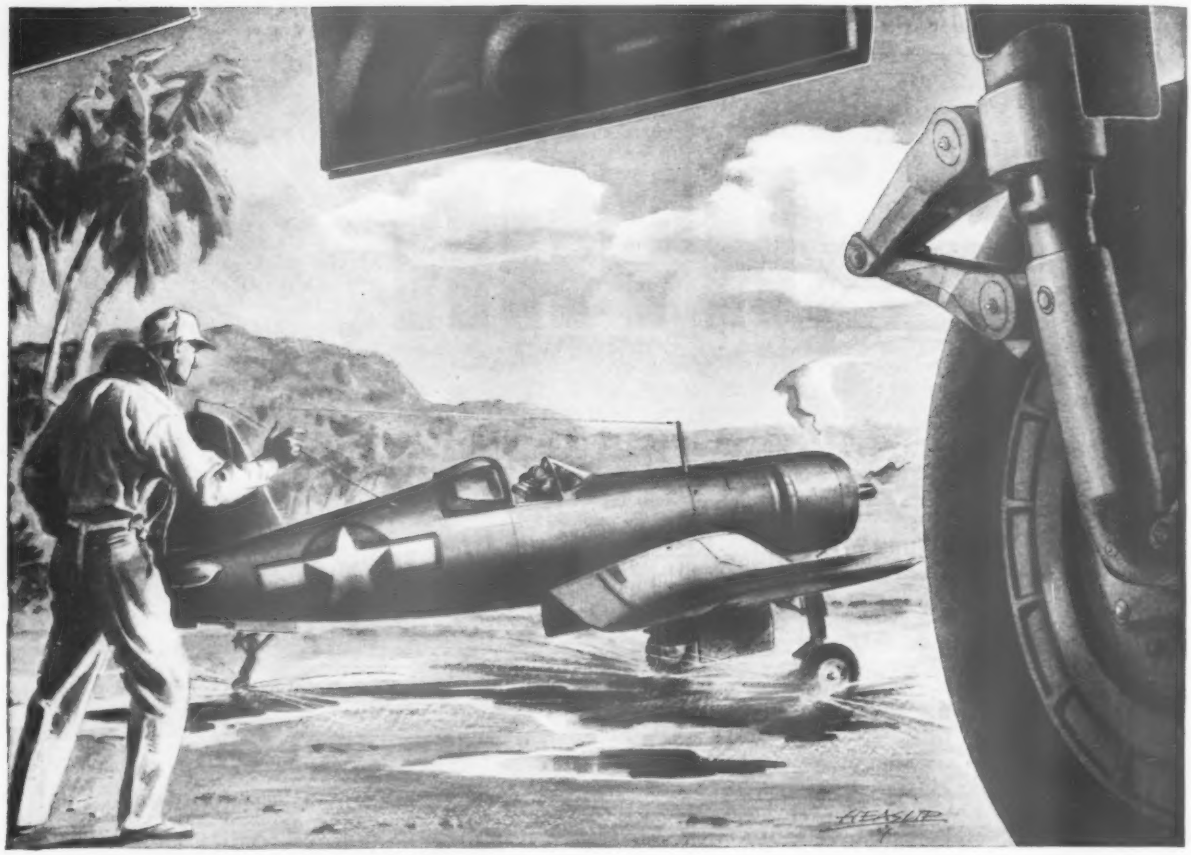
RELY ON RYAN TO BUILD WELL

1922-1945

RYAN *Airplanes*

Ryan Aeronautical Company, San Diego — Member, Aircraft War Production Council, Inc.

DESIGNERS AND BUILDERS OF NAVY FIGHTING PLANES AND EXHAUST MANIFOLD SYSTEMS

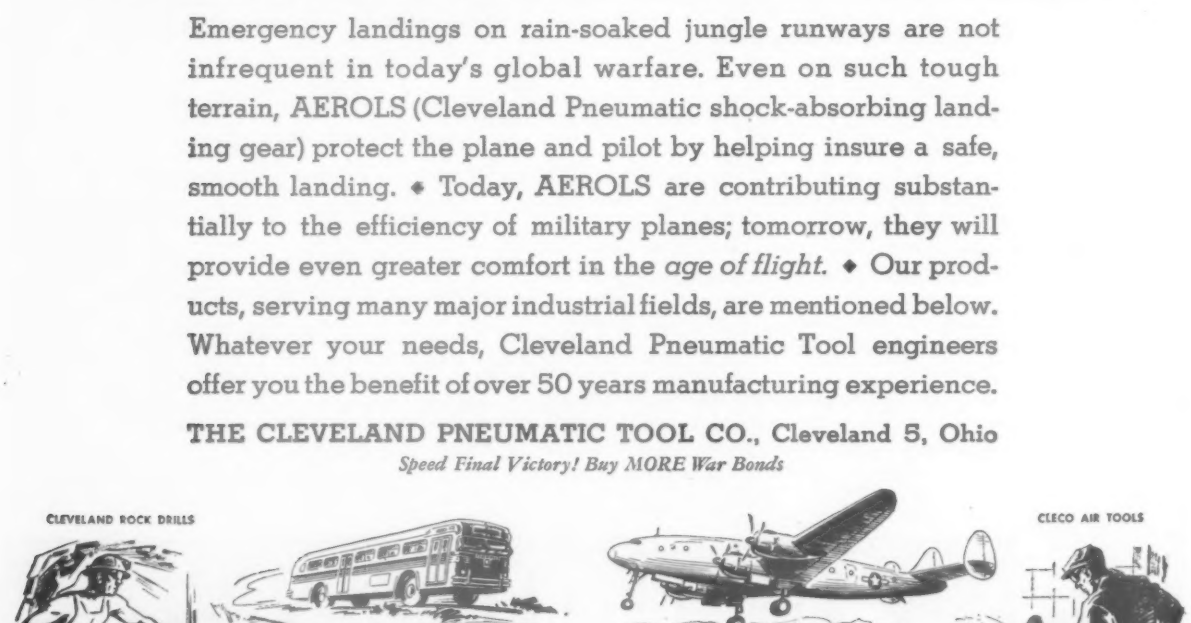


Planes that CARRY *their "landing strips"*

Emergency landings on rain-soaked jungle runways are not infrequent in today's global warfare. Even on such tough terrain, AEROLS (Cleveland Pneumatic shock-absorbing landing gear) protect the plane and pilot by helping insure a safe, smooth landing. ◆ Today, AEROLS are contributing substantially to the efficiency of military planes; tomorrow, they will provide even greater comfort in the *age of flight.* ◆ Our products, serving many major industrial fields, are mentioned below. Whatever your needs, Cleveland Pneumatic Tool engineers offer you the benefit of over 50 years manufacturing experience.

THE CLEVELAND PNEUMATIC TOOL CO., Cleveland 5, Ohio

Speed Final Victory! Buy MORE War Bonds



Our Plan for Private Flying

(*Continued from page 25*)

in the earliest stages of development, will surpass in utility the more conventional type planes. I am being purposely conservative.

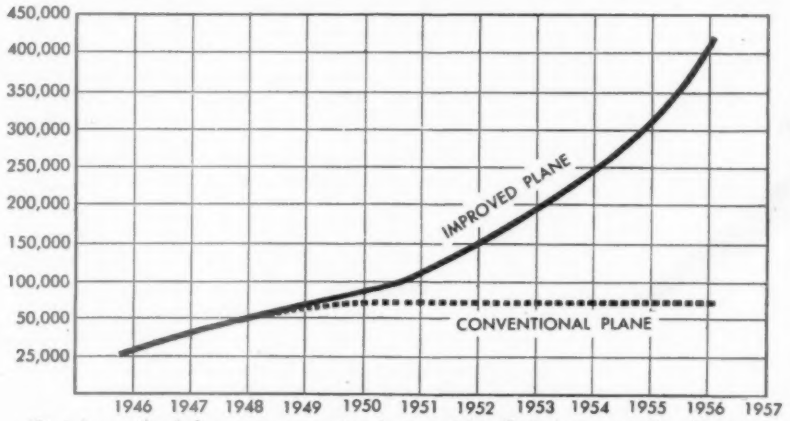
We now have lightplanes that incorporate many safety features all our family planes should have. They are non-spinnable and have simplified controls. I don't see why it wouldn't be possible to build higher-powered airplanes with the same safety features and larger seating capacity. Flaps can be interconnected with the throttle to assure safe landing operation. Perhaps the biggest problem in producing such a craft will be in chopping and shaving the cost down from an estimated $6,000 for such a plane to $2,500, which is about the most that manufacturers can charge and still reach a mass market.

I do not intend to imply that only four-place planes should be sold in quantity. Single- and double-place planes will undoubtedly be popular. But 400,000 planes is a great many and the comparison between the smaller planes and the family models will be something like the ratio between motorcycles, coupes and sedans.

The problem of surplus airplanes has bothered some industry officials. Recently, Government and industry representatives met, and it is indicated that a program will be worked out that will not hurt, and may help, the business. I believe in no big dumping of surplus planes on the market and feel that the great bulk of smaller planes now scattered all over the world will not be brought back to this country.

Since becoming Administrator, I have noticed a healthy interest in the airport situation. Although the CAA has spent $400,000,000 for landing areas in the past four years, the motivation was defense, not primarily development. Now civil aviation is important enough in the national economy to have its needs considered on their own merits. We shall need 6,300 airports within the next five to 10 years to accommodate the expected increase in the number of civil planes.

The location of airports for the convenience of private pilots is a most important consideration in the acceptability of plane ownership as a day-in-day-out proposition. The Sunday pilot doesn't mind much traveling 10 or 15 miles to an airport. But if he is going to make frequent use of his airplane for business or pleasure he wil be as loath to park his plane 15 miles away as he would be now to park his car that far from home. That's one reason why we must develop caster-wheel landing gear. It would permit us to limit the size of airports drastically and locate them close to population centers.



This is how author believes two contrasting designs might affect plane ownership after war.

Private flying is emphasized in our program because we look upon it as the brightest hope for a mass market which will sustain even a fraction of our present $20,000,000,000-a-year aircraft manufacturing industry. That is why we call for an increase in the number of Class 1 and 2 airports from 1,791 to 4,795, while Class 3 or larger fields would go only from 1,151 to 1,510.

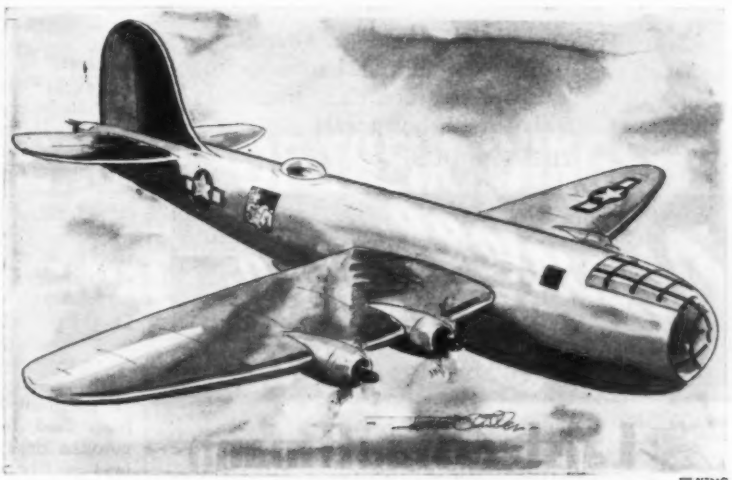
Even if we lick the problem of cross-wind landings so that airports can be located in built-up areas with only one clear approach strip, we are sure to find many residents of those areas objecting to airports in their neighborhoods unless we make aircraft less noisy than they are today. We talk glibly about putting airparks in residential areas to develop popular flying, but we have thought little about the possibility that residents will refuse to permit them in the neighborhood because of the noise nuisance.

The airlines have licked this problem for their passengers but an approach has hardly been made in reducing the noise level for those outside the airplane or even for the occupants of private aircraft. Make no mistake, this question of noise is important in our airport development program. It is a deterrent to flying, too, because it is fatiguing to occupants of a plane and a psychological bar to potential flyers.

We have a long row to hoe in the field of regulation of private flying. Greater public participation will require our simplifying not only regulations but the methods of administering them. I do not feel we can go so far as to eliminate medical examinations altogether, but their severity should be eliminated. Just how far we can go in this respect will have to be a matter of further study.

Similarly, all pilots should know the rudiments of aerodynamics and something of meteorology. I don't see why pilots shouldn't be allowed to tinker with their own engines and get their periodic maintenance checks cheaply and easily. Understand, we have little responsibility for keeping pilots from killing themselves if they insist upon it, but we do have to protect the public. We can't be a police force, so I believe that educating the public in safety is more important in principle than regulating them. The AAA has done a splendid job of educating automobile drivers in safety, and I think we can do the same service.

A boom in private flying will mean that we will have to issue licensing authority to manufacturers and schools. Schools



FLYING

"I been to Ploesti, Berlin, Venice and Saipan, but I ain't yet been to the nose of this ship."

It's a fact!

Two men in a glider soared in the air for 50 hours and 26 minutes

For sheer ecstasy, gliding—sailplaning—is a sport literally "out of this world!"

Do you want relaxation? Step into your *Yankee Doodle Two* and drift with sleek silent wings on a sea of lazy clouds.

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Maybe you don't want to break any world's records but, whether you have plans or dreams, *you want wings for the future...*

If you fly for pleasure—and flying at any speed under 125 miles an hour is for pleasure, not for transportation—then you want

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will be allowed to certificate students who demonstrate their ability to conform to regulations. CAA inspectors will check the instructors periodically to assure that a high standard is being maintained. The same system will be in use in production plants. The commercial inspectors will be allowed to issue airworthiness certificates, but they themselves will be subject to inspection by the Civil Aeronautics Administration. The manufacturers will be held strictly accountable for proper use of their authority.

This easement of regulations can continue, even with some increase in accidents, unless the ratio of injuries and fatalities to the total amount of flying takes a sharp upward swing and refuses to level off. If that point is reached, we shall have to tighten up again.

These then are our present plans. Over the long period no part of the aviation industry holds as much promise of new employment in volume manufacture and in sales and service as private flying. When you compare its potentialities with those of commercial air transport, it is possible that their present relative position may be reversed.

At least, it is the responsibility of those in the private aircraft business and of us in Government to see that the gap between pre-war and post-war flying be bridged. If we do, those estimates of personal flying which now seem fantasies will be met. END

EDITOR'S NOTE: *Mr. Wright speaks for one side of what today is a highly controversial subject in aviation circles. In a forthcoming issue* FLYING *will carry an article by a representative of the aircraft manufacturing industry.*

Super Fuel For Aircraft

(*Continued from page* 53)

ratio, you gain efficiency as well as decidedly increased power.

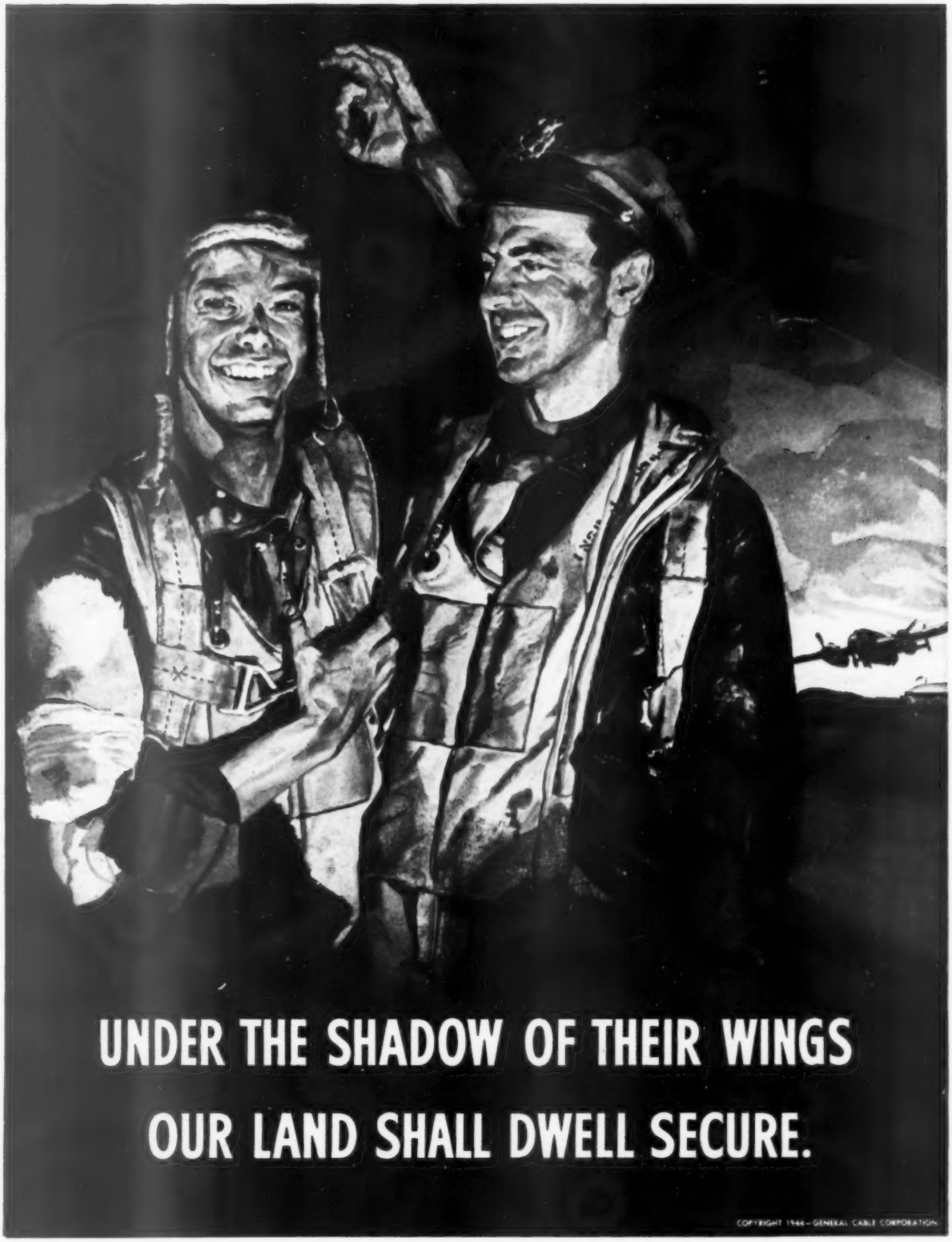
Stated simply, the higher the octane number of a gasoline the more power you can get out of that gasoline and the greater the efficiency with which you can use it. Therefore, an engine designed to use 100 octane number gasoline is more powerful and more efficient than one designed to use 87 octane number gasoline. But you must design the engine to use higher octane—simply putting higher octane than necessary in an engine won't help.

We can note here that an engine designed to use gasoline of lower octane number can be run on 100 octane fuel. There is no increase in power because the engine does not have the necessary compression, but neither is there any adverse effect. Conversely, however, an engine designed for 100 octane but run on a fuel of lower octane number shows a marked reduction of efficiency and may be ruined by detonation.

Today America is producing 100 octane gasoline in quantities which a high Government official a short time ago termed a "near miracle." Actual production figures, of course, are restricted but it has been announced publicly that the country's production has already passed the 500,000 barrel-per-day mark. Early in 1941 a considered military estimate was that this country's requirements of 100 octane for an all-out war would not exceed about 22,000 barrels per day, but the enormous increase in the armed forces' air power has carried with it fantastic increases in demand.

Actually it all started back in the 1920's when scientists first began to give concentrated attention to the problem of gasoline engines. They learned that knocking, or detonation, was increased in severity by an increase of engine compression pressure. They already knew that the higher the compression ratio of an internal combustion engine the greater the efficiency of the engine. Therefore they knew, too, that if they were to increase the efficiency of engines they must first solve this problem of knock. Only then could they safely go to higher compression ratios without running into the difficulties imposed by this detonation.

In the early 1920's, two General Motors scientists, working on possibilities of reducing engine knock by modifying the fuels used, found, among other things, that the addition to gasoline of a rare chemical compound known as tetraethyl lead greatly reduced knock. Shortly afterward, scientists of Standard Oil Company (New Jersey) evolved the process of making this valuable anti-knock agent in commercial quantities and soon afterwards the appearance of "Ethyl" gaso-



UNDER THE SHADOW OF THEIR WINGS OUR LAND SHALL DWELL SECURE.

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In tribute to the courage and the consecrated skill of the fighting fliers of the A. A. F., this war plant poster is gratefully dedicated to those who daily risk their lives that America may be preserved.

GENERAL CABLE CORPORATION

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But we at Franklin—designers, engineers, production men, and management—believe that we must keep our feet on the ground while planning future flying for a peacetime America. All of us—pilots, instructors, distributors, dealers, operators, manufacturers, and others interested in flying—must be cautious in our claims for the future. Don't over-sell flying. Flying doesn't need it.

This doesn't mean that Franklin Engines are standing still but rather that the new Franklin innovations and improvements will be tempered with practical considerations.

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lines heralded a revolution in fuel technology. A remarkable fact in scientific history is that even today—after over two decades of the most intensive and extensive research and the expenditure of many millions of dollars, no better anti-knock agent than tetraethyl lead, nor any better method of making it, have ever been found.

In 1927, Dr. Graham Edgar of the Ethyl Corporation devised the octane number scale for measuring fuel quality. In this method, the knocking of a fuel in a standard test engine is compared with the knock of mixtures of two "reference fuels"—two pure chemicals known as *normal heptane* and *iso-octane* (specifically *2, 2, 4 tri-methyl-pentane*)—one of those eight-carbon-atom isomeric paraffins the dictionary told us about. Heptane knocked very badly—more so than any gasoline known, while in those days it seemed that iso-octane would not knock in any engine. Thus, by mixing the two reference fuels in various proportions, a blend could always be found which just matched the knocking of any gasoline tested. As a measure of knocking quality, the percentage of iso-octane in this matching blend was called the *octane number* of the gasoline.

Another way of defining octane rating is that it expresses the capacity of a gasoline to be compressed without detonating. The higher the octane rating of the gasoline which fuel technicians can produce, the higher the compression of successful engines which manufacturers can make.

To understand how this works, consider what happens inside the cylinder of an airplane engine. The minute the sparks ignite the gas mixture it starts to burn smoothly and evenly. Beginning at the ignition points, the flame burns through the combustion chamber, advancing like a ripple when a pebble is dropped into a mill pond. This normal burning of the mixture results in a *steady* push against the piston that delivers all the power of the expanding gas to the crankshaft. That's what happens in normal, controlled combustion when the correct grade of fuel is burned under normal operating conditions.

But when a lower grade of fuel is used, the fuel starts to burn in the usual way but the burning mixture quickly raises the pressure and therefore the temperature of the unburned mixture to an extreme degree. Now, any inflammable gas has a critical temperature at which it will ignite of its own accord and the unburned portion of the mixture reaches this critical temperature too quickly. It ignites of its own accord and suddenly explodes or detonates with an almost instantaneous, white-hot flame of tremendous violence.

The force of this detonation is what produces the characteristic metallic "ping" called "knocking." These detonations, or super explosions, occurring hundreds of times a minute, release energy in the gasoline so suddenly that much of it cannot be transmitted to the crankshaft as useful power. Instead of getting power we get intense heat which the cooling system cannot carry off. The result is extreme over-heating in the cylinder.

It was thought at first that no gasoline would ever be better than iso-octane, and 100 octane became popularly thought of as a "perfect" fuel. Of course it was not. Obviously, adding lead to iso-octane would make it even better. While the early fuel technologists recognized this, they considered it academic—for who would ever think of using a fuel costing $25 a gallon? Only now, 20 years later, do they realize how wrong they were. Today fuels are known which, even without lead, perform far better than the iso-octane of 1927 which was thought to be the perfect fuel.

These developments in the late 1920's marked the onset of a new era in fuels for automobile and airplane engines. For the first time fuels became available that would not knock when used in engines of higher compression ratios, and a means was available for measuring the quality of those fuels, thus greatly facilitating research. Compression ratios soon increased—a new period in engine development was inaugurated.

The octane rating of military aviation gasoline was soon raised to 87—a noteworthy increase from the World War fuels which were about 65 octane number. The availability of this improved fuel, in fact, made it possible for engine designers to build improved aviation engines and to increase airplane engine horsepower substantially. Nevertheless, by 1932 airplane engines were once again running into fuel limitations. It was obvious then that unless even better fuels were available engine developments would necessarily be limited.

All during this time, however, technologists had been actively at work. As far back as 1928, 1,000 gallons of crude *di-isobutylene* were produced on a semi-commercial scale in a New Jersey refinery and subsequently used to make synthetic iso-octane to augment the limited supply of this valuable reference fuel. The starting raw material at that time was a constituent of refinery cracking coil gases, known as *isobutylene*. This was converted by a chemical process called "polymerization" into the intermediate product *di-isobutylene*. This was then converted to iso-octane by the chemical addition of hydrogen. The possibilities of large-scale chemical synthesis of iso-octane to be used as a high octane blending agent was definitely recognized at that time. A whole new era of synthetic high octane blending agents for gasoline was being opened by these developments.

Thus there entered into the fuel field the first commercial application of a strictly synthetic fuel—synthetic in the same sense that plastics are synthetic—a specific composition put together from purified raw materials to produce a product of definite properties. It was the first major departure from the original methods of purifying or "refining" what nature has provided in crude oil. The door was thereby opened to the whole ensuing development of specific chemical combinations for the improvement of fuel quality. A year later the first Army specification for 100 octane was established, and commercial purchases of the product began.

It wasn't until 1934 that the first im-

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portant experiments with 100 octane fuel under conditions of actual use were carried out by the Army. In May of that year the Army purchased 1,000 gallons of iso-octane, mixed it with an equal amount of high-grade aviation gasoline, added small quantities of tetraethyl lead, and obtained 2,000 gallons of 100 octane fuel.

The results were so spectacular that early in 1935 the Army called for 100,000 gallons of it and followed this up a few months later with a request for bids on 1,000,000 gallons. At this time only three per cent of the few planes the Army had could utilize the gas.

Some idea of what higher octane fuel has made possible in terms of engine performance is obtained if we compare, for example, two well known nine-cylinder single-row air-cooled military aircraft engines—the GR-1820-F50 *Cyclone* engine of 1935, designed to use 87 octane aviation gasoline, with the GR-1820-G200 *Cyclone*, designed for 100 octane fuel. The 1935 engine rates 875 h.p. at 2,200 r.p.m., weighs 1,095 pounds, giving a weight per horsepower of 1.25 pounds. Its mean effective cylinder pressure at take-off is 200 pounds per square inch and at maximum cruising speed it consumes about 0.47 pounds of gasoline per hour per horsepower. The engine designed for 100 octane rates 1,200 h.p. at 2,500 r.p.m., weighs 1,303 pounds, or only 1.09 pounds per horsepower. Its mean effective cylinder pressure at take-off is 244 pounds per square inch, yet at the same cruising power and speed as the F-50 its fuel consumption is less than 0.44 pounds per hour per horsepower. At best economy the difference in fuel consumption is further increased. Today engines have been designed to attain power outputs and economies substantially greater even than those designed for 100 octane.

During the 1930's progress in fuel development was rapid. Early in the decade it was apparent that the supply of isobutylene from refinery gases would seriously limit the production of iso-octane by the polymerization-hydrogenation method. Modifications were made which doubled the yield of 100 octane gasoline from available refinery gases by utilizing normal butylene as well as isobutylene. In 1938 there was announced almost simultaneously in several parts of the world a revolutionary process—now known as *alkylation*—by means of which not only butylenes but many other constituents of refinery cracking coil gases could be utilized to produce high octane synthetic fuels. These are known as "alkylates." Toward the end of 1938 the first commercial alkylation plant in the world was put into operation at Baytown, Tex.

Alkylation is similar to polymerization, involving the joining together of similar gaseous petroleum molecules. This process tremendously increased the potential production of high octane aviation gasoline blending agents and, possibly even more important, it reduced the production cost by eliminating the hydrogenation step formerly required. Actually there are several varieties of "iso-octane," and alkylates produced by the alkylation process are mixtures of these, some better and some worse than the particular iso-octane used in the octane number scale. On the average, though, an alkylate does not quite reach 100 octane by itself. It is, however, of far higher octane number than the best base aviation gasoline derived from crude oil and requires only a small addition of tetraethyl lead to reach the 100 rating.

The war brought almost overnight sharp increases in the demand for high quality aviation fuels. The United States had a tremendous advantage in the existence of commercial processes to make fuel of 100 octane quality, since the Axis nations were not in a position to manufacture this superfuel in anything approaching the quantities now depended on by the United Nations. Even today the Axis has been able to produce only small quantities of gasoline matching the performance of 100 octane.

The sudden war demand for 100 octane aviation gasoline brought the petroleum industry face to face with a tremendous problem. It was not enough to produce great quantities of synthetic iso-octane as a blending agent to raise the octane number of base stock gasoline. Soon the supply of high quality base gasoline became limiting and it was equally important to have available large supplies of such base stock gasoline with which the synthetic fuel and tetraethyl lead could be blended to give the necessary large quantities of 100 octane.

Forunately, during peacetime a new method of refining petroleum, known as *catalytic cracking* had been developed. This process "cracks" oil, with the aid of catalysts, into many compounds and subsequently rearranges the compounds into desired combinations of high-anti-knock quality.

Plants for catalytic cracking, or "cat crackers," are of three types. In one the chemical which serves as a catalyst in the process is in the form of lumps spread out in a bed over which the vapors of the charging stock pass.

In the second type, the catalyst is granular in form and moves slowly as a mass down through the reaction chamber.

The third type, known as "fluid cat cracking," uses the chemical catalyst in finely powdered form which is kept dispersed by steam or petroleum vapors and is then handled like a fluid. Although the fluid cat crackers comprise towering structures containing pipes, chambers, valves and coils, they are unspectacular in operation. The charging stock is gas oil which flows into the cat cracker through pipes. The catalyst is fed into hoppers at the top of a tower in carload lots and joins the charging stock to produce almost miraculous chemical changes which convert the oil into many different gaseous and fluid products. The changes take place under high and carefully-controlled pressures and temperatures. At a certain point in the process the powdered catalyst is separated from the gases and fluids, regenerated by blowing air through it to burn off the carbon which has been deposited on its particles, and is then reused.

Of particular interest in connection with the 100 octane development is the remarkable cost reduction which has been achieved. When the octane scale was devised in 1927 iso-octane was a rare chemical. When first standardized as a reference fuel it cost about $25 per gallon. The early commercial process rapidly reduced this cost until the Army purchased its 1,000 gallons of iso-octane in 1934 at about $2 per gallon and it is to be supposed that the resulting blend of 100 octane cost something over $1 per gallon. Today the cost is considerably less than 15 cents per gallon.

So far we've been talking as if 100 octane were the peak of practical gasoline development. It is hardly that, though not much can be said about higher octane ratings for reasons of military security—except that we have them. The big problem at the present time is making them in sufficient quantity.

Of course, a fuel performing better than iso-octane rates over "100" on the octane

15 YEARS AGO

FROM the April, 1930, issue of this magazine:

Editorial warfare was waged against a proposal of the London Naval Conference that maximum tonnage of American aircraft carriers be limited to 25,000 tons. At that time the United States had only three carriers. One of them, the *Langley*, was obsolete; the other two, the *Lexington* and the *Saratoga*, weighed 33,000 tons each.

Congressman Melvin J. Maas defended a bill he had authored to provide aviation training at colleges and universities under direction of the R.O.T.C., pointing out that it cost the United States about $35,000 to turn out an Army pilot.

A proposal for research in steam engines for aircraft cited 14 reasons for the practicality of the scheme. Among them: greater reserve power for emergency overloads, better control and performance.

Russell Airways, Inc., announced production of "the smallest practical lightplane." Its wingspread: less than 24 feet; weight, 407 pounds; cruising speed, 75, and top speed, 120 m.p.h.

The Fokker Aircraft Corp. heralded its New York showing of "the largest landplane built," the F-32.

A "Forum" complaint read: "Prices of airplanes are rising. In 1927 you could buy a good three-place plane for $2,300; now they want $5,000 for a two-place job."

But a news item announced that cost of the two-place Great Lakes trainer had been reduced from $4,990 to $3,150, and a four-place Stinson *Junior* cabin plane was advertised at $5,775.

Mrs. Blanche W. Noyes (see "Marking Our Aerial Highways" in the February, 1945, issue) had just acquired her transport pilot's license, the 12th issued in the United States to a woman flyer.

Los Angeles County reported 55 airports and landing fields in operation, an average wind velocity of five m.p.h., and 355 sunshiny days per year for flying.

Winged Javelin

Starting in a screaming dive at 8,000 feet this P-51 Mustang pilot is hurling his winged javelin at a Jap artillery position. Right now he is travelling so fast that anti-aircraft guns cannot even follow him. He is in an 80 degree dive. His pull-out will be at "rhubarb height." This is one of the most accurate forms of bombing. The strain on both plane and pilot is terrific, but the P-51 Mustang can take it like American pilots can dish it out.

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number scale, and the original method of measuring quality can no longer be used. There are new methods, though, and for simplicity it may suffice to say that the practice is to use "performance numbers" which, in effect, indicate how much more power without knock—as compared with iso-octane under certain conditions—can be obtained. Present standard fuel for the air forces is 100/130. Translated, this numerical rating means that the gasoline has an octane rating of 100 for cruising and a performance rating of 130 during take-off or for combat purposes.

One of the new high-octane blending agents is triptane, known to the chemist as *2.2.3 trimethyl butane*. Triptane has the highest anti-knock quality of any of the alkylate-type fuels yet developed. It is far better than the "perfect" iso-octane of a few years ago. Triptane developments, however, cannot be generally disclosed.

It seems certain that the post-war era will see extraordinarily high quality fuels—octane numbers or performance ratings exceeding 150 will certainly come into use for some critical applications. On long-range non-stop flights, for example, fuel economy becomes of critical importance. The full possibilities of such high octane number fuels are not yet clearly established, but it is not unlikely that, with such fuels, with engines specifically designed to make the most of them, and with aircraft designed for maximum economy of operation, a 25 per cent saving in fuel consumption and perhaps at least a 10 per cent reduction in engine weight for large long-range aircraft is possible. The economic benefit to shorter-range aircraft is not so great, but is still present.

What all this means to the future of aviation can be predicted with reasonable certainty. First of all, America's engine manufacturers are gaining experience with special alloys to withstand the strain of great power in compact volume, and are developing new engine designs to utilize it.

As for economy, not so long ago engineers in Detroit took a stock Buick car, made the necessary changes so that its engine could use 100 octane, obtained 40 miles to the gallon. Some scientists have estimated that there is enough energy locked up in a gallon of gasoline to drive a car 250 miles. Some enthusiasts believe that we shall see engines equivalent to today's automobile engines but no larger than a typewriter.

The lesson to aviation is clear. There doesn't seem to be any particular need for more peak power in an automobile engine. Therefore the direction in development will be towards small units and economy. All this means lighter weight, less fuel, greater performance in our airplanes. END

Cure for Stalls

(Continued from page 29)

the market, it will probably retail for between $15 and $20, installed. Twenty dollars an airplane seems a cheap price to pay for advice that should save some 125 lives a year.

To understand the principles of all these stall warning instruments, it is necessary to know the nature of a stall. A stall occurs when air fails to flow smoothly over the upper surface of the wing; that is, when the angle of attack becomes so great that the airflow no longer creates lift by the vacuum on the upper side of the wing as well as pressure on the lower surface. Having lost the required lifting power of its wing, the plane begins to fall.

There is a tendency to associate a stall with the position of the aircraft in relation to the ground. Actually a stall is dependent upon the relation of the wing to the flow of air. When speed is reduced to the point where the air stream ceases to pass smoothly over the upper surface of the airfoil, a plane flying level can stall just as easily as one that is climbing. Thus, an airplane will always stall at the same angle of attack regardless of its speed and regardless of the maneuver in which it is engaged. Naturally that angle of attack is reached at a slower speed in level flight than in a bank, climb or similar maneuver.

In order to investigate the aerodynamic phenomena involved, the Gurley company arranged to conduct wind tunnel and flight tests using a strip of tufts arranged around the leading edge of the wing. Over the leading edge, it was observed, airflow broke in a distinct line, parting the tufts half upward, half downward; but as the angle of attack increased toward a stall, the line of demarkation indicated by the tufts dropped down on

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This "something new" is a small parachute placed in the glider tail assembly. When released by the pilot, it acts as a brake or "sky anchor" . . . cutting air speed and permitting faster, tighter landings.

Although this application of the "spin chute" principle for more rapid deceleration may have no appreciable commercial value, it does typify the alertness of WACO engineers to every innovation in plane design or equipment . . . their ability to do new things in a better way. When these talents can again be devoted to peacetime pursuits, you can count on WACO for the plane you'll want to own and fly. THE WACO AIRCRAFT COMPANY, 44 Peters Ave., Troy, Ohio, U.S.A.

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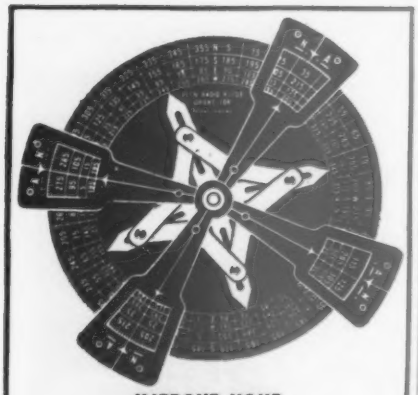

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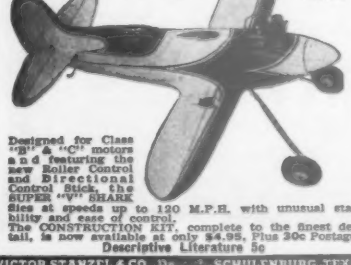

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the leading edge, reversing the direction in which some of the tufts were blown. Various means for utilizing this characteristic in designing a stall-warning device were explored and several versions of a vane-type indicator were tested in the wind tunnel and under actual flight conditions."

The resulting warning assembly has a vane projecting from the leading edge into the air stream. In normal flight, air pressure forces the vane downward. But when the airplane reaches a predetermined angle of attack, the air, which has reversed direction at the point where the vane is located, allows the vane to move upward, closing the switch which actuates the horn-light warning in the cockpit. Simple isn't it? But three years were required to develop it.

Next problem was to locate the vane at the proper angle of the wing. If it were placed on or very near the stalling separation point, the warning would come too late. And if it were put too far from the stalling angle the warning would be premature and pilots would come to ignore it. Knowing the stalling speed of the test airplane in level flight, the researchers found the separation points for various speeds under similar conditions above stalling and tried the vane out. They found pilots liked a warning averaging between 20 per cent and 25 per cent above stalling speed. The plane was then put through all known maneuvers and was found to give adequate warning in every case where a stall was approached by the airport.

Many pilots have been invited to fly CAA planes having the vane warning system, and almost all have expressed their approval. Even skeptical airline pilots have come to favor it. One pilot flying the Fairchild in which this instrument is installed turned around to tell the CAA man that he didn't think much of the "gadget." The conversation diverted his attention and suddenly the horn started its warning. "Whoops, excuse me," he said. "I can see how that it might be a healthy thing to have in an airplane. I wasn't trying it out that time; I just wasn't paying very close attention to my airspeed."

The vane and switch unit are easily installed or quickly replaced from the outside of the wing. They are held in place by a template, require no adjustment, are not easily damaged, and are waterproof.

The second stall warning device gives the pilot the same sort of warning but works on a different principle. It is known to engineers as the diaphragm-switch arrangement and is actuated by pressure reversal at an opening in the leading edge of the wing, a design suggested by Ralph Upson. Personnel of Wayne University, directed by Prof. Arthur A. Locke, conducted the experimental work.

The development of the Wayne University instrument required knowledge of the pressure distribution around the leading edge of the wing for various angles of attack.

This was determined through a series of wind tunnel tests. The difference in pressure between the outside and inside of the wing was determined for a series of openings arranged in a row around the leading edge.

It was learned that at any angle of attack there are two points on the leading edge contour where the pressure differential is zero.

Further, as the angle of attack is increased, those points of zero pressure differential travel downward around the nose of the wing in such a manner that the upper portion of the leading edge suffers a pressure reversal from positive to negative, while the change on the lower position is from the negative to the positive.

After experimenting with several types of pressure-operated switches, the Wayne personnel finally developed a switch unit using a slack diaphragm of a rubber-like material to which is cemented a metal plate. When triggered by a pressure change the diaphragm is sucked upward to make an electrical contact which sets off the warning light and horn. This unit, too, is self-contained, lightweight and compact, but considerably more complex than the vane-switch arrangement. It is expected to be available for purchase at a low price soon and will undoubtedly be installed on many private airplanes to be sold after the war.

Both these devices are suitable for privately-owned aircraft, which are ordinarily not flown through icing conditions. Since ice on the leading edge changes the angle of attack of the wing itself, these instruments would be worthless under such conditions. During the three years 1941-43, 512 such planes were involved in stall accidents, but only five had encountered icing conditions. In the same period, however, two air carrier accidents were attributed to stalls and both planes had encountered icing. Obviously a warning instrument satisfactory for airline craft which fly regularly through ice-laden areas was needed.

CAA's third project, still in developmental stages, is to devise a stall warning instrument that will be dependable at all times, even in the presence of ice. This project has grown from studies made by the NACA as early as 1938, and is based on the belief that the warning must come from the change in airflow on the upper surface of the wing rather than on the leading edge which itself changed contour when coated with ice.

United Air Lines, which has done considerable experimental work in a Boeing 247D with this type of warning signal, used four switches of the diaphragm type at points along the trailing edge of the wing just forward of the aileron. Like the Wayne University mechanism, the instrument they used depends upon pressure reversal to actuate a diaphragm-switch.

Because of the peculiar action of the air stream over the upper surface of a wing when a stall is approached, and the complicating factors during icing conditions, continued research is necessary to perfect the method. Accordingly the CAA signed a contract with Westinghouse Electric and Manufacturing Company for this research. Wind tunnel tests are currently being made at the Carnegie Institute of Technology.

END

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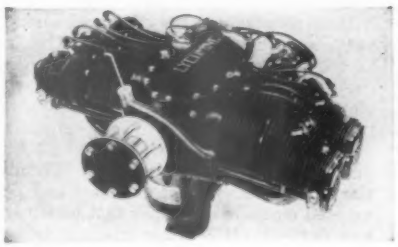

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Report from Washington

(Continued from page 58)

Blaze, followed by the announcement that Elliott had been made a brigadier general . . . We paid a visit to The Hill to see what news of the general had gotten on the public record, but came back with nothing particularly new, except that he has done plenty to win his rank since his appointment as a captain in the Specialist Reserve in September, 1940, including trail-blazing in the North Atlantic and photo-reconnaissance flights in Africa and Europe which, with his Atlantic adventures, won him praise of his officers and his men, the DFC, the Air Medal, the Legion of Merit, and letters of commendation from both Generals Arnold and Bradley. . . . He also is a commander of the Order of the British Empire for outstanding work in the African campaign, and recognition from the Sultan of Morocco entitles the new general to call himself a Commander of Ouissam Alaouite. . . . He's logged more than 1,100 non-pilot hours, 300 of them on combat missions.

Good Organizer

Another thing we came across, hitherto unpublicized, was General Arnold's letter of commendation, dated October 12, 1943, indicating Elliott is also quite an organizer. "The careful and thorough work you have performed in the reorganization of the reconnaissance program of the AAF," Arnold said, "is most pleasing to me and I desire to commend you. . . . Your practical experience has been of inestimable assistance in establishing plans and procedures for the use of reconnaissance units in the field and in setting up new tables of organization based on the actual needs of present-day warfare. . . ."

It also says Elliott had a lot to do with setting up the training program in this country and the reconnaissance command of the Third Air Force. . . . Nor do we mean to neglect Blaze, who turns out to be responsible for some organizing of his own. Chief current item on his record is a three-man sub-committee on the Hill (Senators Bridges, Maybank, and Stewart) who, inspired by Blaze, are investigating the whole priority system, not only by air, but by rail and ship. The senators reported that everybody on the Hill had been flooded with instances of abuses following Blaze's publicity, but said they were saving details for public hearings. . . . One other item with which, justly or unjustly, the now-famous dog is credited: For days after he bumped the two sailors, switchboard operators at ATC headquarters in Washington were dogged by phone calls which invariably began, "Bow-wow-wow, I want a priority!"

Close Shave

Sometimes it takes quite a while for news to get through to us from the front, but when it does it's worth the wait. Our favorite at the moment concerns a masthead attack on a Jap convoy by a flock of *Havocs* . . . The pilot of a wing plane, in making his attack run, got caught in the explosion of bombs from the lead plane. Debris from a Jap ship filled the air, but he managed to get through and bomb another vessel before returning to base. . . . Inspection of his plane revealed numerous holes and dents in the forward section of the *Havoc* caused by the wreckage—plus the Jap ship's log, papers, cargo listing, and a list of the convoy personnel. They had been blown into the air intake of the bomber's oil cooler system. . . . And then there's the story of Lieut. James Clifton Whitley, stationed somewhere in Italy, an ordnance officer on a *Flying Fort*. Wounded in action, Lieutenant Whitley, while recuperating in a base hospital, got into a conversation with an Italian barber who was shaving him. . . . One thing led to another and it finally developed that Whitley had shot the barber down in an air battle earlier in the war. The little guy with the razor had been piloting a Macchi 202 over Naples when Whitley picked him off. . . .

From a *Lightning* pilot in Italy we have received the following suggestion: "When too much enemy competition gets on your tail, set your plane on one wing, gun the lower prop, chop the top one, and then give opposite control. You'll black out, of course, but when you next take a look around there won't be an enemy plane in sight!" Let us know how you make out. . . .

Radar from the British

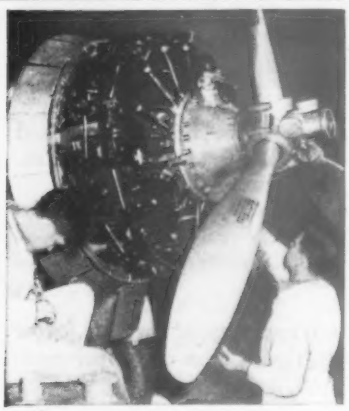
While British sources complain about "wide publication" of aircraft radar in the United States, the British magazine *Flight* has more to say about at least one radar device than any American magazine, up to now, has dared to say. . . .

"Briefly," says *Flight*, "the 'black box,' used for bombing through clouds is a radio transmitter emitting a signal which travels at light speed, i.e. 186,000 miles per second, impinges upon reflecting surfaces of any and all objects within its field and bounces back, at the same speed, to the receiver unit in the aircraft. In fact, its operation is a version of the echo principle.

"Here the signal is translated electronically on the ordinary cathode-tube principle to the object screen set before the observer, the image seen upon the screen being a reproduction of the ground being flown over. Water shows up as darker patches through the greenish fluorescence of the screen illumination whilst solid objects, houses, ships, etc., are indicated as lighter patches, the outline of which is roughly similar to their plan-form. Thus, a town over which the aircraft is flying will be represented upon the screen as an irregular shape of similar outline to that seen visually by an observer looking down with no interfering clouds."

Most clouds offer no "bounce"—hence radar sees through them. ". . . The invention," asserts *Flight*, "together with almost every other radar device, was completely British and, in conformity with the bi-lateral agreement between America and England, we presented them with full details of everything we knew. Technicians in the U. S. then got busy and developed on their own lines that which we had devised. It is quite truthful to say that a great deal of the scientific equipment used by the Allies is of American *manufacture*, but as far as radar is concerned, the concept and development spadework is British and, quite naturally, most of our own forces are equipped with British-made devices.

"Although the device is being used at the moment primarily for bombing attacks, there is obviously a tremendous future for it in a civil world. What with this and the various other equally remarkable instruments evolved and per-



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THE "GOONIE-BIRD" landed in rugged shape one afternoon ... 2 engines out ... another leaking oil ... hydraulic system out ... control cables half gone; two men eligible for the Purple Heart.

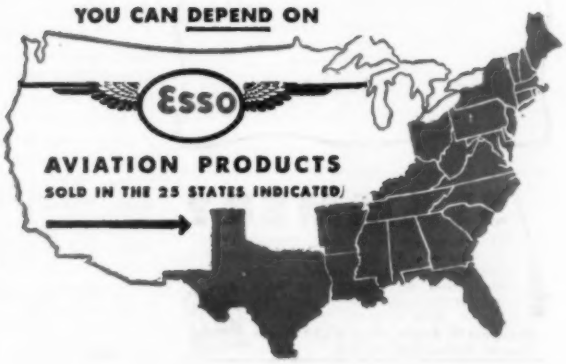
Then Casey took over, Casey the Crew Chief, and his gang of mechanics. They worked all that night ... in a downpour. They didn't have any regulation block and tackle to dismount the engines. So they used a palm tree and a ship's hawser instead. And in 16 hours, they took out 3 engines; mounted 3 new ones; repaired the hydraulic system and installed new control cables. Then two of the mechanics flew as gunners in the Goonie-Bird, to replace the guys wounded yesterday.

Men like these mechanics have got inside them a great hunk of that special American brand of mechanical genius and ingenuity. They'll come home with a whale of a lot to contribute to the factories and airports of the nation; and quickly and permanently, men like these will establish America as the leader of the world in commercial aviation.

Handmaiden to a High-Powered Lady...

FORTY YEARS *of matchless experience, the finest of laboratories and test blocks, comprise the authoritative background of Esso Aviation Products.*

And as the result of our extensive wartime research and production, we have acquired new knowledge and know-how in the field of airplane fuels and lubricants, which results in aviation petroleum products more efficient and more economical than any that have been known before. You can depend on Esso Aviation Products.



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No wonder! The one and only CHAP STICK is especially medicated to soothe and relieve *chapped, sore, cracked, parched or dry lips* caused by extremes of heat or cold!

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Now—A Resident Flight School for Young Women Exclusively

For you who want to make use of the modern method of personal transportation, the Alabama Institute of Aeronautics, the resident school for young women exclusively, offers you flight and ground school instruction to qualify you for your Private Pilot Rating in a 12 weeks' course. Experienced instructors have successfully trained military fliers since 1939.

Residence Halls and Dining Hall are conveniently located on the campus. The Institute bulletin provides complete information. A post card request will bring you your copy. Address

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Tuscaloosa, Alabama

Alabama Institute of Aeronautics

145 Columbus Road, Tuscaloosa, Alabama

STAMMER?

This new 128-page book, "Stammering, Its Cause and Correction," describes the Bogue Unit Method for scientific correction of stammering and stuttering—successful for 44 years. *Free—no obligation.*

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fected, all-weather commercial flying in safety appears to be in sight."

Boomlet

If reports coming into Washington from CAA regional managers are any indication, a sizable boom in lightplane flying is already on the way. . . . From the West Coast comes word that 35 per cent of the student pilot certificates issued last year were to residents of the restricted zone. In most cases, holders had to travel more than 150 miles to get flying time. H. A. Hook, CAA regional manager at Santa Monica, also reports that winter applications were abnormally high, flying clubs are on the increase, "flight training increase will be enormous" when military restrictions are lifted, and "practically all operators within the zone have requested permission to conduct flight training." . . . Regional Manager L. C. Elliott, reporting from Fort Worth, had an average of 1,100 student permits per month for the last six months of 1944. "Crop dusting and crop seeding have increased immensely . . . and it is believed this will continue." . . . Student registrations in the second region, headquartered at Atlanta, almost doubled last year over 1943, says manager W. M. Robertson, and Harold R. Neely of the third (Chicago) region had 15,000 student certificates in 1944. . . . The boomlet is reaching the grassroots. "Most of our present operators who hold primary and advanced flying school certificates," writes Regional Manager W. E. Kline, headquartered in Kansas City, "have been sending instructors with one aircraft to communities of 500 to 1,000 population to give flight instruction to five to ten students." Plane sales have followed the instructors. Kline also reports that 75 per cent of the students are under 25, 35 per cent between the ages of 16 and 18.

Don't Look Now But . . .

. . . there is a 20th and a 21st AAF Bomber Command, the 20th based in China, the 21st on Saipan. Both are getting in some powerful licks against the Japs . . . North American Aviation bid approximately $50,000 per plane—we said fifty thousand dollars—lower than the next lowest bidder for construction of the Fairchild *Packet* (C-82). Total N. A. contract runs to $150,000,000, the first 25 planes on a cost-plus basis, the rest on a fixed price . . . North American was also low bidder for the new Lockheed fighter, winning a contract in excess of fifty million dollars. On the basis of these bids, J. L. ("Dutch") Kindelberger, N. A. president, is looking toward post-war competition with a wide grin. . . .

The Howard Hughes wooden plane, a-building at Culver City, is said to have a wing span 40 feet longer than a football field, a tail 110 feet high, and eight engines. It's expected to have a test flight soon now—Henry Kaiser predicted its completion in eight months about three years ago—and for all we know the pilot and co-pilot will be Paul Bunyan and John Henry, with Baron Munchausen as flight engineer. . . . At U. S. Strategic Air Force Headquarters in southern England recently, Lieut. Gen. "Jimmy" Doolittle and his staff, moved at sight of real winter weather, dropped war-time duties for a snow-ball fight. . . . Germans were reported late in the winter to be using coal in their jet-propelled planes to evade the acute shortage of other fuels. Their short-range JP or rocket fighter has an estimated speed of more than 600 m.p.h. Pilots fly it on their stomachs. . . .

Mortar-Board Aviation

From a present enrollment of 20 students—several of them war vets—the University of Tennessee's (Knoxville) courses in airport and airline operation and management are planned to expand to 100 students next fall. The present program, financed by the Tennessee Bureau of Aeronautics, will continue through June, word from there indicates. . . . The airport-airline management course was established last August and has already become useful, furnishing technical advice to Chattanooga in the reconstruction of Lovell Field, and to Milan, Tenn., for its proposed municipal airport. Inquiries are also being serviced from Cleveland, Johnson City, Clinton, and McKenzie concerning airport projects. An extensive technical library for lending throughout the state is also being built up. . . . Next big program on the fire is a master state airways and airports plan, to be worked out by university students and instructors.

Briefings

From East St. Louis we hear that Oliver L. Parks, president of Parks Aircraft Sales and Service, has laid another strip of smooth highway on the road to post-war lightplane flying. This time it's in the form of reasonable prices for lightplane enthusiasts at Curtiss-Parks airport: 73 octane gas, 21 cents per gallon; 80 octane, 26 cents; engine oil, 30 cents per quart. Hangar space is available for

(*Continued on page* 142)

CONTROL LOCK

MADE from scrap material, this adjustable control lock board uses a thin strip of metal with spaced holes to fit into the narrow space between the wing and aileron on smaller planes.

Designed by J. Earl Steinhauer, assistant manager of Washington National Airport, it can be used on wings of various thickness by moving the peg into different holes.

Pacific Airmotive, aviation's oldest and largest maintenance and supply company, announces the opening of a new $500,000 base at Anchorage, Alaska.

NOW in operation, PAC offers—

. . . The finest and most complete aircraft engine and accessory overhaul, maintenance, service and supply facilities.

. . . Stocks of supplies—actually in stock.

. . . AMSCO and PAC "shop-tested" service equipment.

Chart Anchorage as a prime service point on your world airway's map.

Other PAC bases:

BURBANK	Lockheed Air Terminal
GLENDALE	6265 San Fernando Rd.
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PACIFIC AIRMOTIVE

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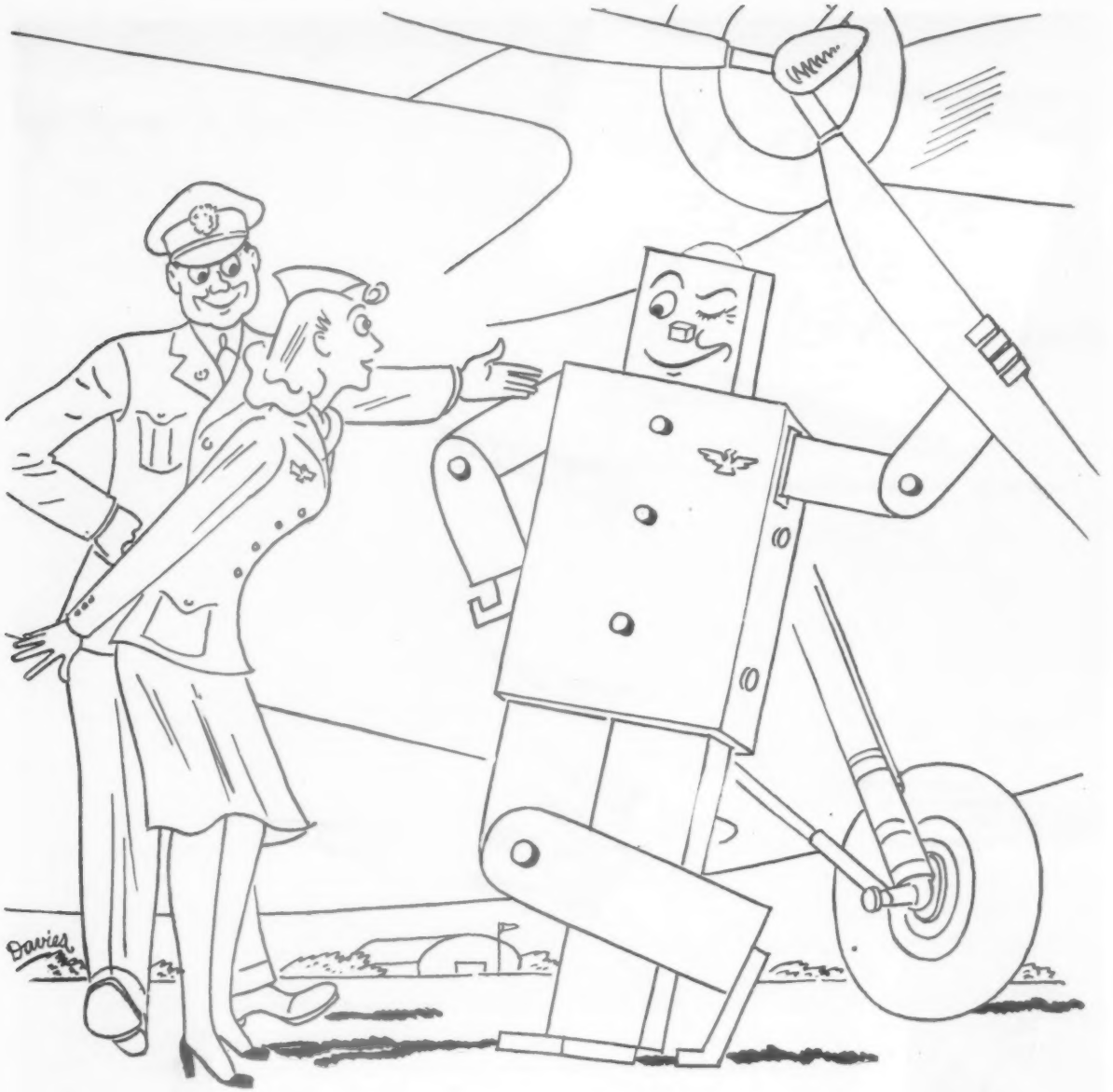
-SUPPLIES COVER THE FIELD



"Meet our new co-pilot"

There's no telling just how far science will take us in the next decade of progress in aviation. But there are some indications as to the direction it is likely to take.

For one thing, the ability of the petroleum industry to furnish commercial quantities of better than 100-octane gasoline after the war automatically opens up opportunities to improve the performance and economy of post-war airplanes.

You are already familiar with the tremendous advances made possible by the widespread use of 100-octane gasoline containing Ethyl fluid—particularly in military planes. However, 100-octane is by no means the ceiling. Experimental fuels with antiknock ratings so high that they cannot be expressed by the octane scale are already in production. By blending these fuels with Ethyl fluid the petroleum industry will be able to offer super-octane aviation gasolines.

The period immediately following the war may well become one of experimentation aimed at finding the most effective methods of utilizing these super fuels.

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THERE'S A BIG advantage in having intricate parts produced by a single organization under single, controlled responsibility. No buck-passing, no costly delays. Long before Pearl Harbor we built a reputation on volume production of industrial and aircraft engine parts, large or small, hardened and ground, micro-finished.

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While we're now geared to total war output, we may have an open capacity on your parts problem . . . so why not write our Executive Sales Office for an impressive booklet on our complete plant facilities.

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● *THE SUCCESS of The Aeronautical Products, Inc. Helicopter, designed and built by our own craftsmen promises new accomplishments in the post-war age of flight.*

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DETROIT PLANT and Administrative Offices: 18100 Ryon Road, Detroit 12

API

OHIO PLANT: Washington Court House Ohio

(*Continued from page* 138)

as little as $14.75 per month and mechanics work at $2.50 an hour. . . .

John Groves of the Air Transport Association has been called in as an expert to advise Harvard Business College researchers preparing a report on post-war airport problems. He was former manager of Washington National Airport here.

Post-war week-ends in Paris seemed a notch closer recently with the announcement that a *Skymaster* had set a new U. S.-Paris round-trip record—50 hours and five minutes. The run was made to and from the New Castle Army base in Delaware in No. 309 of the Second Ferrying Group, a plane formerly on the New Castle-India run, where it also broke a record, doing the 22,000-mile round-trip in 148 hrs. 10 min. flying time. . . .

Could be that the Wallace-Jones battle will eventually effect the status of CAA? If the Senate is determined to strip Wallace down to a nubbin of power, they might listen to Congressman Clarence F. Lea of California, who now has a bill up to remove civil aeronautics from Commerce control. On the other hand, with Wallace riding in the Commerce saddle, Congressman Lea might change his mind about the evils of a Commerce-dominated civil aviation set-up. . . .

Behind Congressman Karl Mundt's advocacy of what he calls "an international peace patrol of the air" in the post-war world are a number of influential leaders in civil aviation, including Roscoe Turner of the NATA. . . .

To ETP (the equi-time point), mythical "town" in the trackless Pacific where NATS pilots must decide whether they have enough gas to get them where they're going, has been added another "community" called Jones' Corner. That's where they make their only change of course about midway in the long sky route between San Francisco and Honolulu and beeline for their destination. END

London Letter

(*Continued from page* 47)

any certainty and until they are the matter cannot be settled.

If rocket drive is considered, the Germans can probably claim priority with their Opel experimental flights of 1929. And in putting into operational service an airscrewless drive the Germans again can claim priority with their impulse duct engine in the flying bomb.

Snap Tactics

Official top speed figures for the Messerschmitt Me-262 and the Messerschmitt Me-163 being about 500 and about 600 m.p.h. respectively, these aircraft have presented a nice problem in tactics to RAF pilots of *Tempests* and *Spitfires* who try to shoot them down.

A method which has had some success is based on the fact that the jet and rocket pilots prefer to slow down and turn on a small radius rather than sweep out on a very wide, high-speed turn. So the *Tempest* or *Spitfire* pilot, if well controlled from the ground, waits above the enemy until he sees the beginning of a turn. He then closes at the highest possible rate of speed.

Sufficient study of what the RAF calls the "form" of the German pilots usually reveals that effective dealing with even their latest types and fighter tactics largely involves seeing the weak spots quickly enough.

Civil Flying Jobs

In mid-January the Guild of Air Pilots and Air Navigators of the British Empire (the organization which creates a world's record in clumsiness of title) issued a book on post-war civil aviation prospects.

The book was the outcome of an idea first put forward by Capt. A. G. Lamplugh of the British Aviation Insurance Group. It surveys the civil aviation field and makes cautious estimates of the scope for employment, pointing out that the qualities needed in the civil airline pilot are not the same as those needed in the service pilot.

The survey puts the salary a qualified airline pilot might expect from a British company at £1,500 ($6,000) a year. It says that only a very small number of those now in the RAF can hope to obtain posts in civil aviation. It doubts if air line operators will find the post of flight engineer, except when doubled with that of second pilot, economic.

Aerial survey by improved photographic methods is thought to be a growing business and it is suggested that newspapers may find it useful to own and operate their own aircraft. The Director General of Civil Aviation, Sir William Hildred (his knighthood was announced in the New Year's Honors list) contributes a preface to the Guild's published book.

Weir Helicopter

Work on British designs of helicopters and other kinds of rotating wing aircraft such as the autogiro, has mostly been in abeyance during the war. But a new helicopter designed by the same group that was formerly so active in developing the autogiro and who had on its staff the inventor himself—the late Senor Don Juan de la Cierva—has been finished and should soon fly.

James Weir is backing the company. He has already spent a fortune (some say $1,015,000) on developing rotating wing aircraft.

Detachable Lift

An astonishing scheme has been seriously considered for providing transport vehicles, jeeps and the like, with their own detachable lifting apparatus. The idea is to give them a sort of portable windmill, like the top part of an ordinary *Autogiro*—the rotor and main shaft. This is attached to the jeep which can then be towed into the air, the pilot sitting in the ordinary driving seat. Released near the place it is wanted, the jeep can windmill safely to the ground—or that is what those working on the scheme hope will happen. END

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Fluorescent Maps

NIGHT map reading is made easier aboard blacked-out Allied planes by means of transparent fluorescent plastic envelopes. A cellulose acetate plastic incorporating fluorescent pigment emits a minimum glow sufficient to make descriptive material covered by the envelope visible under the "black light" of rays near the ultraviolet. The envelopes also provide a virtually inexhaustible writing pad, since markings on them may be erased and the surface reused many times.

From the Eighth, the Ninth, the Fifth . . . the Twelfth, Fifteenth, and other veteran AAF . . . they have been drawn to staff the Twentieth—only Air Force of global commands.

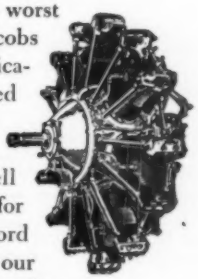
Operations wise, combat crafty, trial tested by English winters, sub patrols, Pacific distances, desert drought, tropic jungle . . . these men are well schooled in strategy and surprise, tactics and individual action. Stranger still—each is the cherished child of Luck who has surpassed the grim statistics of his trade, survived all dangers hostile skies can show.

Now in the great new gleaming bombers, these sons of Fortune can bring home to Nippon a boxcar load of bombs . . . and say with Scriptural certainty, that the Lord hath delivered their enemy into their hands!

In all the legends of fighting men, the rosters of the Caesars and great Genghis Khan, the scrolls of Charlemagne and the Crusades, the shining chronicles of courage . . . Earth has not seen nor History known their like before!

These are the Great Inimitables, incredibly of our day. Watch for the shoulder patch, with the "20" between the Air Force wings, and honor them for what they are! So much have these men given—and so much still is theirs to give . . . that no one of us can match their gifts, even in gratitude.

For the huge training program of the USAAF and our Allies, this company has manufactured more than 20,000 Jacobs engines—and over 10,000 of another make—for use in twin-engine planes used to school bomber personnel.

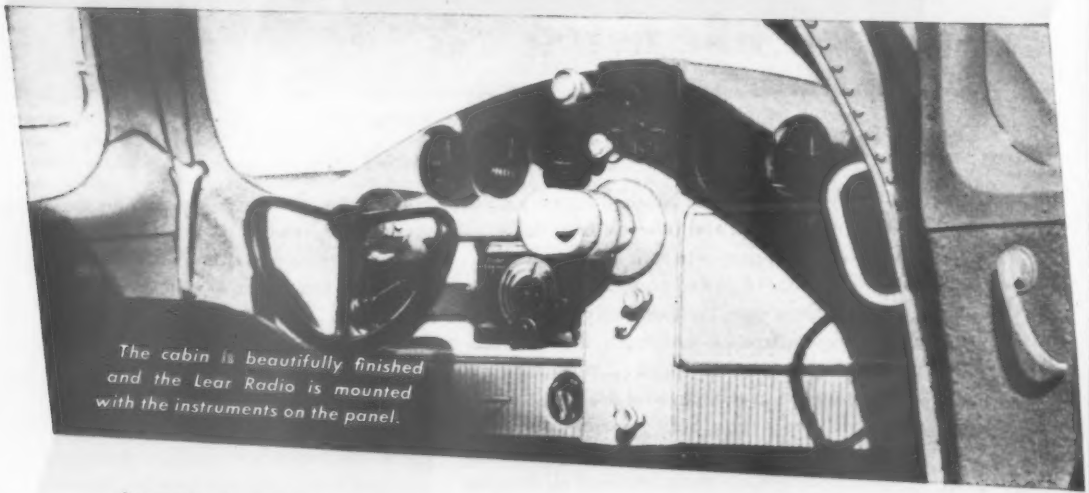


Used in training, subject to the worst wear known to plane engines, Jacobs engines delivered far beyond specification or expectation . . . have increased their rated service period between major overhauls from 350 to as high as 1200 flight hours . . . served well the student airmen, saved money for the taxpayers, and established a record for performance and stamina that, to our knowledge, is unmatched by any other engine . . . For transports, freighters, feeder and lighter airplanes, there will be Jacobs engines suited to postwar needs, capable of continued performance, minimum maintenance and very low costs . . . Jacobs Aircraft Engine Company.

JACOBS · **Pottstown, Pa.**

Republic Aviation Corporation's new postwar amphibian flies with Lear Radio. This experimental model is Lear-equipped and all tests have been flown with it.

Looking Ahead with Lear



The cabin is beautifully finished and the Lear Radio is mounted with the instruments on the panel.

A new plane is stretching its wings. Kin to the Army's famous fighter, Republic's Thunderbolt Amphibian will make its bid as the postwar personal plane.

Grouped with the instruments on its neat panel is a Lear Aircraft Radio. For Republic knows well the long successful history of Lear in producing fine radios for the exacting needs of flying.

Since 1930, Lear has been a specialist in fine aircraft radio instruments and direction-finding equipment. They have won a reputation for being light, keenly sensitive and unusually dependable.

Of course, all Lear production now goes only where Uncle Sam says. But aircraft operators can look ahead to the days when Lear aircraft equipment, improved and developed by its work in war, will again be available.

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Lear INCORPORATED

So You Want to Start an Airline?

(*Continued from page 49*)

examined at the conclusion of his presentation. The examiner assigned to the hearing presides and rules on all controversial points that may be raised. The applicant may present his own case if he so desires; he does not have to be a lawyer. There are no requirements for admission to practice before the Civil Aeronautics Board.

At the hearing each applicant is given full opportunity to present his case and supply certain necessary background information concerning his proposed operation. The Board evinces particular interest in "whether the new service will serve a useful public purpose, responsive to a public need; whether this purpose can and will be served adequately by existing lines and carriers; whether it can be served by the applicant without impairing the operations of existing carriers contrary to the public interest; and whether the cost of the proposed service to the Government will be outweighed by the benefit which will accrue to the public from the new service. Whether the inauguration of service on the proposed route herein considered is in the public interest must be determined with these considerations in mind."

Two broad phrases which appear in the Civil Aeronautics Act and are frequently encountered by applicants seeking authorization to operate an airline are "public convenience and necessity" and "fit, willing, and able." More specifically, under "public convenience and necessity" the applicant will attempt to prove that there is a present and future "need" for the air service he proposes to operate. This cannot be accomplished by letters of recommendation for the proposed new service but will require the introduction of facts and figures showing the need for the service.

There is no precise formula to follow although information on the economic characteristics of cities along the proposed route, and those of other cities within a 25-mile radius will prove valuable. Some significant factors are population of these cities, type of manufacturing plants, the value and amount of war material produced, the yearly value of all manufacture, the size of payrolls, and whether there are any military establishments to be served. The number of telephones used in these cities, the number of income tax returns filed, the volume of retail sales, and amount of incoming and outgoing mail and freight, are figures of importance in determining the economic background.

Travel trends along the proposed route should be studied and the facts presented as evidence showing the "community of interest" between cities. Hotel registration figures for the past five years will prove helpful in showing what outside cities have an interest in the new route territory. Points of origin and destination of travelers, mail and freight, and long distance phone calls will tend to show the natural flow of the area's trade and travel connections. If the applicant's proposed route has been planned with such factors in mind, such facts and figures will help support his case.

The applicant should not lose sight of the fact that the Board must also weigh his application from a national viewpoint. Will the proposed new route help develop a sound air transportation system "properly adapted to the present and future needs of the foreign and domestic commerce of the United States, of the Postal Service, and of the national defense?" Will the new route improve the postal service and will there be a saving in travel time and distance by addition of the route to the national system?

Applicants wanting to serve areas already being served, partly or fully, by existing air carriers, will find that the operating carrier will usually intervene in the hearing. Depending on the selection of the proposed new route the existing carrier will introduce evidence estimating how much of his traffic will be diverted by the applicant. Sometimes, and again depending on the route planned by the applicant, the proposed new service may actually feed business into the existing service. In any event, the Board will carefully compare any estimated loss to the existing carrier, caused by competition from the potential new carrier, against the *need* for the service.

While the Board protects existing air carriers from attack by unwarranted competition, it favors "competition to the extent necessary to assure the sound development of an air transportation system" in accordance with the Act. In a recent case dealing with parallel operation between two large cities by rival air carriers, the Board declared:

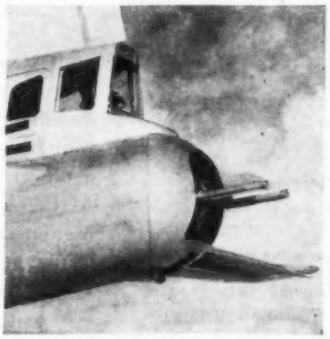
> "The Act thus implies the desirability of competition in the air transportation industry when such competition will be neither destructive nor uneconomical and the Board is directed to implement such competition as will fulfill the purpose of the Act. While no convenient formula of general applicability may be available as a substitute for the Board's discretionary judgment it would seem to be a sound principle that, since competition in itself presents an incentive to improved service and technological development, there would be strong, although not conclusive, presumption in favor of competition on any route which offered sufficient traffic to support competing services without unreasonable increase of total operating cost. How that competition would be provided would depend upon the facts and circumstances of each particular case."

There are many other factors of importance that each applicant may individually develop in proving the "need" for service that will meet the "public convenience and necessity." No list of such factors could ever be considered conclusive. A very helpful rule to follow is to stick closely to evidence based on facts and figures rather than on hopes and guesses.

Before issuing a certificate of public convenience and necessity to an applicant, the Board must be fully satisfied that the applicant is "fit, willing and able" to perform the proposed service. It is at once obvious that in applying to the Board for permission to operate, the applicant has demonstrated his "willingness." Whether he is "fit" and "able" must still be proven.

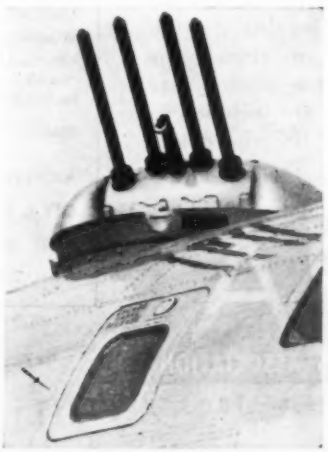
It will be recalled that one of the six questions the Board requires to be answered in the original application concerns what ". . . type of aircraft applicant proposes to use in the new service and whether such aircraft is presently owned by the applicant." With hundreds of applications presently on file with the Board, and the known difficulty of purchasing suitable commercial airline aircraft at this time, it is pertinent to quote

(*Continued on page 148*)



B-29 CHANGES

SINCE going into combat, the Boeing *Superfortress* has been under constant modification. Two of the most recent changes are the removal of the 20-mm. cannon in the tail, leaving just two 50-cal. machine guns (top picture). The remotely-controlled forward top turret (below) was changed to a four-gun turret, instead of the original two-gun turret, now may go back to the two .50's.



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AOPA's long-range program will be of vital importance in America's great postwar period of aviation. Why not join us now in planning for the future? If you have soloed you are eligible for membership in AOPA. The fee is only $5.00 a year and the free services shown above are included in your membership. Write, or use the convenient coupon on this page.

AOPA SPEAKS WITH the voice of thousands of members—all of them brother pilots. Where the individual would be helpless, this organization is a powerful protective force in his behalf. Just as AOPA has been a leader in fighting restricting regulations which would hamper private flying, so is it constantly engaging in many other activities which are aimed at making private flying safer and less expensive, more useful and more enjoyable. Every non-scheduled pilot is invited to join this national non-profit organization of flyers and owners. The AOPA is "the automobile club of the air"; it is group protection for flyers that you, as a pilot, cannot afford to miss.

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HARLEY-DAVIDSON
MOTORCYCLES

(*Continued from page* 145)

from a Board opinion handed down in 1941:

> "In determining the fitness, willingness, and ability of an air carrier in past proceedings, the Board has never found it reasonable to establish the immediate availability of aircraft and personnel as a test, but has considered it adequate that a proper organizational basis for the conduct of air transportation should have been established; a plan for conduct of service made by personnel shown to be competent in such matters; and the availability of financial resources demonstrated."

While it may relieve the non-operating applicant to learn that he does not have to own aircraft prior to the hearing, careful and competent organizational planning must be submitted as evidence. Certificated air carriers need not do this since their financial background and operating record are known to the Board. Before any new service is authorized, however, the Civil Aeronautics Administration, in accordance with the Civil Aeronautics Act, must find that the applicant is properly equipped for safe operation. The Board itself will devote attention to safety considerations in those cases seeking to utilize new and relatively untried equipment, such as helicopters, and the applicant must support his case.

Finally, when an applicant receives a certificate of public convenience and necessity from the Civil Aeronautics Board, he does not necessarily receive a contract to carry the mail. This is accomplished only when the Postmaster General, according to the act, shall certify to the Board a finding that a new route for the transportation of mail is required. If the Board then finds that this is required by the public convenience and necessity, a certificate is issued.

Commercial air service route mileage certificated by the Civil Aeronautics Board now covers some 63,527 miles in the United States. Piece by piece the pattern of a sound air transportation system is being assembled. The machinery shaping that pattern is the Civil Aeronautics Board in Washington, but it is the spirit, courage and vision of American free enterprise that is providing the material. END

The 'Mail Order Command'

(*Continued from page* 60)

by the statistical control of AOASC with respect to *movement* of material overseas.

Intransit Depot No. 5 at the Newark base operates on the principle that "the most efficient intransit depot is an empty one." The goal is to have shipments routed out as fast as they come in—so fast that no item requires storage. The millions of cases handled make it impossible for the ideal to be fully realized, but there is a complete turnover of all cargo on an average of at least twice a week.

The supply of organizational material to all types of overseas flight bases for the USAAF alone is a gigantic task. But the AOASC also transmits organizational material on lend-lease to the United Kingdom, Australia, New Zealand, India, China, Russia and South America. The bulk of it goes to Britain and Russia. In addition, the Newark base serves as the country's largest processing and transshipment center for fighter aircraft. All of these functions are performed by a personnel organization of approximately 341 officers, 1,789 enlisted men (including some 191 WACS) and 4,312 civilians.

Now, all this movement of requisition and materiel is not happening like shots in the dark. Every step, every shipment, every movement is closely controlled. And the heart of the control system is the Office of Statistical Control, as the accompanying flow chart shows.

What's the status of tachometer Item No. 7777 in Requisition No. 4444? How much of that item is available for shipment? At what stage of transmission is it? At the ATSC Specialized Depot? En route to Intransit Depot No. 5? En route overseas? How many cases of "red label" cargo on hand for shipment abroad—and let's have that information broken down by destination. What's the consumption rate of belly tank No. 9999 at Base No. 3333 overseas? How many cancellations on crash truck No. 2222 from the Italian theater for the month of August?

These are only a very small sampling of the extent and diversity of information that the supply division and statistical control are called upon to furnish, often on a few minutes notice.

The Office of Statistical Control really resembles a huge commercial office—dozens of desks at which dozens of girls are working in a vast space bordered by offices and conference rooms. But over at the left are two doors marked "restricted." Behind those doors is the mechanical nerve center of statistical control. Here, in a long room, you see an array of some 90 machines created by the International Business Machines Company. The Office of Statistic Control makes these machines do everything but talk. Cards by the million go into and out of them and are then automatically transferred from one file to another. The only card that ever stays put is the one that sums up everything that has gone before and is filed as history. The entire operation is completely mechanized.

When shipments arrive at the intransit depot from the various ATSC specialized depots and other consignors the cases are sorted as to ultimate destination (which is in code, naturally) and are then subsorted within destination by requisition or project number. For warehousing, the requisition number category is further broken down by shipping ticket number. Each case is measured exactly and its size is noted in measurement tons (one measurement ton equals 40 cubic feet). The status card entries were considered good enough for general advance planning but, for exactness in space allocation, meas-

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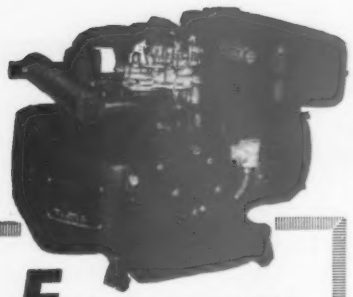

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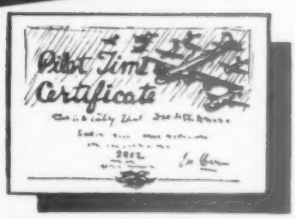

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urement is made on the spot at the intransit depot to provide the loading organization at the port of embarkation with precise data for its task.

Within a few hours of its arrival at the intransit depot, every case has stapled on it an envelope of punched cards containing full information about the case—what's in it, where from, where to, when, how much, how many, etc. These cards are subsequently used for comparison with check-up information supplied by statistical control to Intransit Depot No. 5. The comparison is made by the stevedores at the depot.

A curious sidelight is the facility with which these men have learned to read the cards. All information on the cards is in the form of punched holes, not in writing or in type. The information on the card can be determined only by interpretation of the punches. Yet the stevedores simply hold the cards up to the light and read the holes as if they were so many words and numbers. They have developed such speed and accuracy that, as statistical control personnel will tell you, even some of the old hands in the office can't match the best of them.

It would be hard to imagine a tighter control than the one existing here. Nothing that has any practical relevance to the functions of this unit of the Air Forces is omitted. And if the system is releasable after the war, which is probable, it is likely to find wide application in the world of commercial distribution. The equipment utilized for the system is not mechanically new, except for an occasional modification for a specific purpose. But the character and extent of work which the equipment has been made to do in the control function will prove of practical value to the business world.

On the basis of the work done by the Office of Statistical Control of the AOASC, paper work has been minimized for our Air Forces supply bases overseas. Since the same mechanized control set-up has been installed abroad by this command and since experts trained here function over there, the card information transmitted overseas is quickly and easily interpretable.

In the main administration building at the Newark base is the Office of Control, the co-ordinating unit for the whole set-up. In the Office of Control is a room that has no windows and is sound-proofed. Three of its walls bear charts that tell the progressive history of overseas supply. The fourth wall is entirely occupied by the "menu board"—a board with moveable white plastic letters and numbers on black velvet, which provides up-to-the-minute information on every category of material that has gone or is going to every overseas theater, whether for our own forces or, under lend-lease, to our Allies. Co-ordinated information compiled in this Control Room is set down in a manual called Activity Charts, which is distributed to and used by other units of the Air Service Command.

And all of this technical rigid control is devoted to the main end of seeing that each of the millions of items needed by our forces everywhere reaches the right place at the right time. It is logistics streamlined. END

Make My Plane Useful

(*Continued from page 52*)

The reasons are interesting, the most repeated one being that flying was too inconvenient. Too expensive came next, and these two reasons hold the crux of the whole private ownership question. Unless an airplane can be roadable, and thus more useful than it is today, the number of people who will buy it—and continue to use it—will be seriously limited. And if only a few buy it, it will always be a luxury item. The only place to attack this vicious circle is at the point marked "utility."

This group of ex-owners is probably the best list of immediate prospective purchasers. They have succumbed to the thrills of flying. They have put out money and pocketed their losses as plane owners, but it is a good bet that they would start flying again in a plane which they could afford. They should be, and probably are, the first to demand more of the airplane than it has yet produced for them.

There is also the typical American householder and family head. He has been reading about helicopters and private planes so much recently that he has undoubtedly looked over his back yard with a wondering eye, estimating his chances of operating his family air car from home plate. He needs only a demonstration flight to convince him that a roadable plane will supplement, if not almost supplant his automobile.

There is also another and much smaller group of potential airplane owners. They are the experienced pilots who are already inescapably sold on the airplane as it is. Several of them, likewise, have come out with specifications for the kind of airplane they want. It is usually a twin-engined, four-place monoplane, capable of flying with full load on one engine and having complete instruments for blind flying and complete radio equipment. There you have a fine plane for a millionaire, or any owner to whom the expense of employing a private pilot, $2 to $5 a night storage costs, taxicab fares to and from airports, big home hangar and maintenance costs mean nothing. But not for you and me. Not for a million you-and-me's, even in this filthy rich America of ours. The private airplane industry has developed—and grown lean—on this type of owner. There just aren't enough of them to support a sizeable industry.

What is needed is a four-place, roadable plane. Roadable, for two principal reasons: to enable us to keep on going on the ground in bad weather and end that tiresome business of waiting at airports for weather to go over; and second, to make us independent of expensive ground transportation at the beginning and end of every airplane flight. The plane should sell in the neighborhood of $1,000. That usually gives the aeronautical engineer a laugh and sometimes apoplexy. He moans

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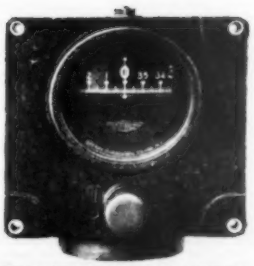

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about the cost of labor, the cost of materials, the expensive nature of airplane structure, and usually winds up by saying that this is not a matter of turning out an egg beater or a shoe rack or an automobile in quantity. We have to start from scratch, he says, in producing a family airplane.

Starting from the McDonnell *Doodlebug*, or its like, is not starting from scratch. Starting from the Waterman is not starting from scratch. Starting from the biggest manufacturing plant in history is far from scratch. Starting with 2,000,000 or more skilled aviation factory workers is certainly not from scratch. It appears that the scratching will have to be done on the engineers who can and should design a practical and versatile plane-automobile.

Unfortunately, it is not only a question of what the engineer can design, nor of what the manufacturer can build at this time, nor of what they want or do not want to try. Nor is it a question of what any particular wishful thinker happens to drag out of his typewriter. This is an "or else" proposition.

The hard, cold fact is that to meet the demand, a four-place, roadable plane, selling at about $1,000 is the absolute necessity. Either we have a plane like that or we have no plane industry, no matter how much we scream or prophesy.

Why shouldn't a vehicle like this come out of the National Advisory Committee for Aeronautics? You'd probably have to warp a word or two in the enabling act, but what better "advisory" service could a Government agency render the people than to assemble all the pertinent knowledge and co-operate with industry in wind tunnel and other technical assistance?

If there is no possibility of such a roadable, versatile plane, there are millions of Americans who will say to the manufacturers, "include me out." The automobile-plane score will still stand at 27,000,000 to 25,000.

Whether there is such a plane or not, there are a few thousands, perhaps a few tens of thousands, who will buy a conventional, "restricted" type of plane, and aviation will continue to be the most interesting, the loudest—and one of the smallest — of our transportation industries. END

Plane Design Fundamentals

(*Continued from page* 62)

It is very easy to expend a great deal of weight in the injudicious routing of engine controls and other items around structural components. The typical connections between the cockpit and an engine on large multi-engined airplanes weigh from 10 to 20 pounds per foot of run. It is therefore preferable to take the weight by penalties upon the structure in preference to using an elaborate routing of the equipment. Sometimes the most "efficient" structure in the eyes of the structural engineer is not the lightest. Structural engineers frequently describe structures as efficient which have all of their material working. In many cases a simpler structure will weigh less than one of the more efficient ones.

The increase in electrical generator output from 600 watts to 7,200 watts with only a 40 per cent increase in weight may be taken as an example of the latent improvements possible in many fields. Another example is the development of a new type aircraft electrical conductor. This new wire is not only lighter [60 pounds saved per airplane on the *Skymaster*] but is also fire resistant and superior to all other conductors in high and low temperature bending and abrasion resistance.

Airplanes are the most complex objects in quantity manufacture. Interchangeability of components therefore is not only of great interest to the users but compulsory for the manufacturer. As is becoming well known, assembly and installment operations constitute 80 per cent of the man hours in the manufacture of aircraft.

The full meaning of this is not appreciated by many engineers and vendors. Most people, including those in the automobile industry, used to think that the fabrication of the sheet metal parts of an airplane was an important part of its manufacture. This is far from the case. Use of common sheet metal methods and special techniques developed by the aircraft industry makes the fabrication of sheet metal parts a job of great interest but of no particular importance or difficulty.

The principal problems in aircraft manufacture are two in number. The first, and by far the most difficult, is to schedule and keep track of the great number of parts involved. The second problem is to have parts that fit after they are manufactured. There are three types of errors associated with manufacturing operations which cause changes in dimensions during manufacture and thus will cause parts to be in error even though the tools are perfect.

Thermal effects produce one of these difficulties. Unfortunately, aluminum alloys have a thermal coefficient of expansion of approximately .000012 in. / in. / F° while the coefficient for most ferrous materials is near .000006 in. / in. / F°. As aluminum parts must be made with steel machine tools and in steel jigs, there will be only one temperature at which the aluminum parts will have the correct dimensions. In ordinary shop work this difficulty is not acute since most of the parts, being ferrous, have the same thermal cofficient as have the tools used. For small aluminum parts the errors introduced by this cause are still negligible. As an example, take a part 10 inches long manufactured 10° hotter than the base temperature. Since the differential coefficient of thermal expansion of aluminum alloys and steel may be taken as .000006 in. / in. / F°, the part when it is returned to the base temperature will be too short by 10x10x.000006 in. / in. / F°, or .0006 in.

This is not a very serious error, for in airframe manufacture the tolerances gen-

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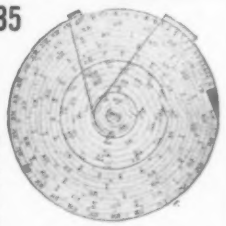

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erally are at least ± .010 in. But if we take the case of a large wing attachment with a 100-inch spacing between bolts and consider the problem of field interchangeability of a wing made in summer and a center section made in winter, assuming a temperature range of 50°, which is easily possible in badly heated southern plants, we find that the misfit will be 100x50x.000006, or .030 in. This mismatch assumes that *no other errors exist* and may be in either direction. In order to be interchangeable the end holes would have to be made at least .015 inches oversize. This problem is not theoretical. It occurs continually even with parts made at different times of day in the same plant.

Another source of errors in parts is the changes in dimensions caused by various manufacturing processes. Heat-treated aluminum alloys, in common with other materials, have internal strains introduced by heat treatment. When such a part is machined it will warp in such a manner as to give up some of the potential energy stored by the heat-treat process. A part 130 inches long shrinks approximately ⅛ inch during machining or approximately .001 inches per inch of length. Some parts warp when the stresses are relieved unsymmetrically.

In general, welding operations cause components to shrink. Theoretically, spot welding can be made distortionless by recompressing the spots on a modern spot welder, using the forging effect of the recompression cycle to compensate for the shrinkage in the spot weld. Spot welded assemblies are as variable as riveted assemblies since the result depends more on workmanship and tooling than the process.

There is another major difficulty due to the very nature of aircraft. Weight is so critical in all aircraft that extreme efforts are made to conserve it. These efforts result in an airplane being made of thin materials working at high stresses, resulting in very large deflections in many airplane structures. In the DC-3, for instance, the wing tips are 20 inches higher in relation to the body while in the air than when on the ground. More modern airplanes have larger deflections due to the development of structures of greater efficiency designed to smaller load factors. Because of this flexibility, fuselages frequently sag as much as 1½ inches on being removed from their jigs. Other parts deflect noticeably on being removed from their supports. This results in airplane doors not being interchangeable on our airlines.

After making a number of airplanes, the doors can be made a shape that approximates that of the fuselage and then be handworked into the individual fuselage. The problem of making truly interchangeable doors will probably never be solved unless large weight sacrifices become possible.

These deflection troubles do not seem to be well enough known to aircraft component manufacturers. One such concern, in spite of many protests, recently made a gun turret which mounted to the fuselage with 16 feet. The design was inoperative in flight and a tubular ring had to be squeezed in and mounted to the fuselage at three points in order to make the turret operable. Deflections of .002 in. to .003 in. per inch of run are rather common in aircraft. Careful designers frequently lay out cable fairheads so that they will be straight in flight and mount tubing so that it has sufficient flexibility to accommodate itself to the large structural deflections of its supports.

Importance of safety and weight and the difficulties encountered in manufacturing and servicing airplanes merits foresight and pessimism on the part of designers and vendors of aircraft components. They should bear in mind this rule-of-thumb: (1) Parts and devices must be "fail safe;" (2) airplanes must be built and serviced by simple tools and simple minds; (3) actuating systems must be autonomous and last, but hardly least, simplicity pays off: END

Letters

(*Continued from page 82*)

and the fact they fly "tiny C-54's." So do we fly the four-engined stuff. My particular line flies Boeing *Stratoliners* (and C-54's). And remember plenty of the airline boys flew ATC routes all over the world.

You don't have to be "superman to check out as captain on the airlines" but you do have to *wait your turn.* We employ a seniority system and some of our best pilots waited four and five years for a crack at the left seat. If Mr. Bush thinks two years is too long to wait, he should talk with some of our "old boys" with 15,000 to 20,000 hours who flew co-pilot for years.

CAPT. C. C. CONNICK, TWA
New York, N. Y.

WHAT'S IN A NAME?

Sirs:

Some of us yearn for the star names for airplanes once used by Lockheed. Recalling the *Vega, Altair, Orion, Sirius* and *Electra,* the *Lightning* seems out of order although the name does suit the plane's action. What about the suitability of names such as *Capella, Rigel, Aldebaran* and *Regulus?*

Superfortress has a schoolboyish ring to it. How about a new name—say the *Conqueror,* the *Nemesis* or the *Titan?* Names mean much; let's pick right ones.

HENRY R. BINET
N.S.W. Australia

SUGGESTED RULE CHANGE

Sirs:

Recent issues of FLYING have cited many regulatory problems which have discouraged both student and private pilots and have led to the decline in ownership of lightplanes.

I believe consideration should be given the idea of permitting the instructor to issue private licenses. He teaches, soloes and supervises the cross-country training of the student and should know his ability better than any other person. Like-

(*Continued on page 156*)

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(*Continued from page* 154)

wise the airport licensed mechanic should issue the airworthiness certificate for aircraft since he has given it attention throughout the year. He knows the status of the plane at all times. These changes would conserve flying time.

MAJ. GEO. J. GRANT

European Theater

REVERSE THRUST AND JATO

Sirs:

Your article in the January issue "Do Runways Limit Plane Size," is highly interesting and informative.

It seems that the problem of adequate landing strips for larger and larger planes may be solved by use of two developments already past the experimental stage —auxiliary jet propulsion for short take-off runs and reverse prop braking to supplant the current "let-the-old-cat-die" technique after landing.

Won't these render unnecessary the long and costly runways now under consideration?

ARTHUR W. STEVENS

Boston, Mass.

● A possibility. See "Rockets and Aircraft" in February issue of FLYING and "Reverse Thrust" in the March issue.—ED.

WEIGH YOUR WORDS

Sirs:

I question your caption for a color photograph on page 64 of the January issue, which reads: "Weighing In a Navy *Ventura* (PV-1) at the Lockheed Factory."

I am an aircraft instrument instructor and mechanic. My experience leads me to believe that the photo depicts the ground swinging of the *Ventura* for proper compass location and compensation. Am I correct?

SID T. BORGEN

Chicago, Ill.

● Right. The *Ventura* is on a compass rose at the Lockheed plant.—ED.

Flight Pay in the Services

(*Continued from page* 50)

pay to their legal dependents. However, at all times an officer may authorize deductions from his pay for insurance premiums. In case of capture by the enemy the Secretary of War is authorized to continue payment of any allotments while the officer is held as a prisoner of war.

Allotments (Enlisted Men): Either the enlisted man or members of his family (wife, children, parents, brothers and sisters who are chiefly dependent upon him) may apply for benefits allowed under the Servicemen's Dependent Allowance Act of 1942 as amended October 26, 1943. Twenty-two dollars is deducted from his pay and his wife will receive a total of $50 per month, plus $30 for one child and $20 for each additional child. A partially dependent mother may receive $37 a month or $50 if completely dependent. And so on.

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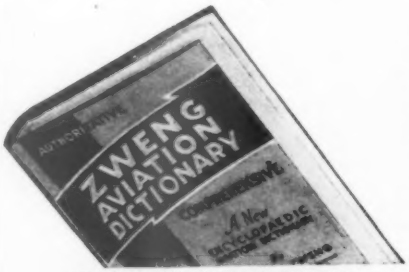

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No. 3 - TRICYCLE LANDING GEAR

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SIX REASONS FOR CULVER'S IMPROVED TRICYCLE RETRACTABLE LANDING GEAR

IN THE pre-war period Culver built a number of ships with the standard bicycle gear. In the war period Culver has been building specialized purpose airplanes with tricycle gears. The experience of having built ships with both types of gear gave us a background of comparison, and it is the considered and expressed opinion of Culver pilots and engineers alike that the tricycle gear should definitely be incorporated into the new commercial Culver.

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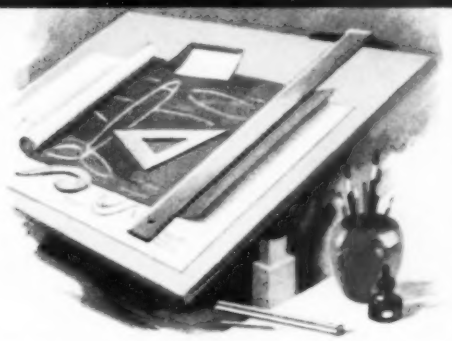

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